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ARMSTRONG (T.). **The Life History of the Peach Borer,** *Synanthedon exitiosa* **Say, in Ontario.**—*Sci. Agric.* **20** no. 10 pp. 557–565, 2 pls., 2 graphs, 15 refs. Ottawa, 1940.

Aegeria (*Synanthedon*) *exitiosa*, Say, has recently caused increasing injury to peach throughout the Niagara Peninsula and western Ontario. The larvae bore irregular tunnels in the bark or outer wood slightly above or below ground level and in the main roots, and trees less than three years old, especially if newly planted, are frequently killed by the attack. The egg, the cocoon and the adults of both sexes are briefly described, and an account is given of observations in 1935–38 on its life-history.

In the orchard, eggs were laid singly or in batches on the ground or on the trunks and foliage of the trees, and in cone cages round the tree trunks they were laid on any available object. The egg stage lasted 9–25 days, depending on temperature, and averaged about 12, and in the laboratory the young larvae crawled downwards and away from the light. Hatching began in the field at the end of July and continued until the end of September. The presence of the larvae in a tree can be detected by the fragments of bark heaped round the entrance hole on the trunk, usually close to the ground. Feeding continues until cold weather sets in, when the larvae hibernate in rough cocoons in the feeding cavity or on the outside of the trunk in a loose jelly-like exudation. Feeding is resumed in spring and continues throughout July, while some larvae continue to feed in August and even September and overwinter a second time. In an experiment in which moths were confined in cone cages round the bases of peach trees in 1937, 39 per cent. of the adults of the following generation emerged in 1938 and the rest in 1939.

The cocoons in which the larvae pupate are usually constructed in an upright position just below the surface of the soil and within 3 ins. of the trunk, but in the case of individuals with a two-year life-cycle, some of which feed deep in the main roots, they may occur as far as 14 ins. from the trunk. The total period spent in the cocoon by individuals collected in the field lasted 18–43 days, with an average of about 28.

The adults were present in the orchards from the second week in July until about mid-September, most of them emerging during August. Pairing and oviposition usually take place on the day of the emergence, and the oviposition period of individual females ranged up to 16 days but averaged about 4. The greatest total number of eggs laid by a single female was 962 for starved individuals and 1,278 for those fed on a weak solution of sugar. Feeding the moths once a day on the solution increased the average total number of eggs from 478 to 653, and the average female longevity from 6·2 to 8·7 days.

To investigate the attractive power of the females, a newly emerged unfertilised example was placed in a trap in an apple tree about 600 yards from the nearest peach orchard. The moth survived for 10 days and males were attracted for 7. The total number taken was 12, two of which were taken in the first hour. When three females were placed in the trap, ten males were attracted, four of them on the first day.

There is, apparently, a high natural mortality among the immature stages of the moth, and particularly among the very young larvae before they establish themselves in the tree. When 31 females

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were placed in cone cages round the bases of 12 trees and allowed to complete oviposition, only 66 adults emerged during the two following years. If, as the rate of oviposition in the insectary suggests, the original females laid an average of 500 eggs each, this represents a mortality of 99·57 per cent. Parasitism of *A. exitiosa* in the Niagara district is apparently of only slight importance, since no parasites were secured in 1935, 1936 or 1938, and only two species were reared from cocoons in 1937, these being *Microbracon sanninoideae*, Gah., of which as many as 16 adults were obtained from a single host, and *Phaeogenes ater*, Cress. The percentage parasitism was 2·5.

PICKETT (A. D.) & NEARY (M. E.). **Further Studies on** *Rhagoletis pomonella* **(Walsh).**—*Sci. Agric.* **20** no. 10 pp. 551–556, 8 refs. Ottawa, 1940.

The results are summarised of breeding experiments with Trypetids of the genus *Rhagoletis* that infest apple, blueberry [*Vaccinium*] and hawthorn [*Crataegus*] in Nova Scotia, from which, together with morphological studies, the senior author concluded that these flies, and those that infest snowberry (*Symphoricarpus racemosus*), all belong to the single species *R. pomonella*, Walsh [*R.A.E.*, A **25** 471]; and an account is given of further work with the apple, blueberry and hawthorn flies in 1936–39 in which the breeding technique was similar, except that the mixture on which the flies were fed consisted of 5 per cent. honey and 2–3 per cent. yeast in equal parts of fresh milk and distilled water. The results, which are given in tables, together with those of 1934–35 [*loc. cit.*] showed that the apple flies possess considerable adaptability, since they produced offspring that reached the mature larval stage in fruits of blueberry, hawthorn, pear, plum, mountain ash (*Sorbus americana*), snowberry and sweet cherry.

The blueberry flies were less adaptable, but were induced to lay eggs, from which larvae developed, in apples, plums and haws. Only two mature larvae were recovered from haws, however, after many trials. The hawthorn flies readily oviposited in apples, giving rise to further adults, but snowberry was the only other fruit on which they could be induced to lay eggs. Only 1 and 2 pupae were obtained from 80 and 25 flies, respectively, caged with this plant. The fact that the tendency to select the normal host-fruit is least strong in the apple form supports the view that all these flies have originated from a single American species, since apples have been grown in America for a relatively short time. All the other fruits regarded as natural hosts are native. With one possible exception, larvae of *Rhagoletis* have never been found by the authors in the fruits of introduced species of hawthorn, although these are common in some of the districts in which apples and native hawthorns are heavily infested.

In further cross-breeding experiments [*cf. loc. cit.*], mature larvae were bred in apples from apple females and hawthorn males and from apple females and blueberry males, but blueberry females and apple males did not reproduce in apples or blueberries. Adults from a cross of apple females and blueberry males reared in apples in 1935 paired among themselves and gave mature larvae in apples in 1936, and those from a cross of hawthorn females and apple males reared in haws in 1935 paired and gave larvae in haws in 1936. An attempt to cross blueberry females with hawthorn males failed, but only small numbers

were used. The blueberry form emerges considerably earlier than the hawthorn one, and it is difficult to obtain both at the same time.

The authors consider that their investigations suggest a close relationship between the apple, blueberry and hawthorn flies, and that there is no sound basis for considering the blueberry form specifically distinct. Food-plant influences have a bearing on the seasonal development of the flies, the appearance of which is synchronised with the prime condition of such plants for oviposition.

OMER-COOPER (J.). **Remarks on the False Codlin Moth.**—[1] 12+8 pp. multigraphed. Grahamstown [? 1940].

Argyroploce leucotreta, Meyr., is probably indigenous in South Africa, but this cannot be demonstrated because *Citrus* was introduced and the moth known as a pest of it long before 1913, when it was described. It has been recorded from a variety of fruits, a list of which is given, but, except in the case of guava, in which D. Gunn bred adults from which he reared a second generation in *Citrus*, the evidence is not conclusive, owing to the difficulty in identifying both the adult and the larva. Although acorns are stated to be heavily attacked in some districts, infestation is slight in one *Citrus* orchard near which oaks are numerous. The author has examined an adult obtained from cotton in Tanganyika and believed to be *A. leucotreta*, but he considers that it probably represents a distinct species or variety, since it differed slightly from the form that occurs in the Bathurst district.

It is generally believed, although it has not been proved, that in the Bathurst district, where infestation of *Citrus* by *A. leucotreta* is greater than elsewhere, the moth migrates into the orchards from the bush each season but is also able to breed there continuously; the great fluctuation in numbers from year to year in orchards where sanitation has been consistently practised indicates that, in some years, infestation is augmented by immigration.

The bionomics of *A. leucotreta* are described, partly from the literature. Females deposit their eggs singly or in small clusters on the fruit, and these hatch in about 9 days. One of the newly hatched larvae, after eating any eggs or other larvae that it encounters on the same fruit, burrows into it, discarding the particles of the outer rind and feeding on the inner rind and the pulp but not on the juice, which appears to be harmful to it. The mortality on Valencia and other smooth-skinned oranges is high, as the larvae find it difficult to enter them. When fully fed, or earlier if parasitised, the larva leaves the fruit to pupate; at the beginning of the season, this takes place after the fruit has fallen, but later as many as 14·5 per cent. of the larvae emerge before the fruits fall, and at this time many larvae still in the fruit die, probably as a result of the high juice content. Pupation takes place in a cocoon constructed on the surface of the soil, generally in a crack or depression, and covered with particles of soil; adult emergence is prevented if the cocoons are buried beneath an inch of soil. The length of the larval stage appears to vary widely under different conditions, periods of 12 and 173 days having been recorded. The adult emerges 20–40 days after the formation of the cocoon, and this period includes a prepupal stage that also varies in duration. The adults are active by night, and males and females are present in

approximately equal numbers. They survived for 2–3 weeks in the insectary, and mating and oviposition took place when they were provided only with water.

The eggs are parasitised by *Trichogramma luteum*, Gir., but the percentage parasitised is generally low, although in one orchard in which infestation by *A. leucotreta* was slight it exceeded 90. The larvae are attacked by two parasites ; only one occurs in the Bathurst district, but in an orchard where no sanitation was practised, it was responsible for 12·2 per cent. parasitism.

Methods of control are discussed. In the author's opinion, sprays are injurious to the trees and do not produce the good results claimed for them. Control of *A. leucotreta* by biological means is considered unlikely to succeed in South Africa in general, since, if the species is indigenous, its parasites and predators, together with their controlling agents, are most probably also present. In the Bathurst district, however, the introduction of the second larval parasite may prove successful. The high degree of infestation in this region is attributed largely to the lack of pruning, which hinders orchard sanitation and protects the moths from predators. Sanitation, however, cannot protect an orchard if there is extensive immigration from the bush.

Appendices contain suggestions for experiments to determine the value of control by means of the introduction of an alternate host of *T. luteum* and the encouragement of predators ; the extent to which immigration from wild food-plants affects isolated orchards and orchards in which complete sanitation is practised ; and the cause of a great difference in the degree of infestation observed in two orchards situated within 150 yards of each other.

HARGREAVES (H.). **Report of the Senior Entomologist.**—*Rep. Dep. Agric. Uganda 1938-39* pt. 2 pp. 5–9. Entebbe, 1940.

Monthly records of the incidence of the pink bollworm [*Platyedra gossypiella*, Saund.] on cotton at Serere indicated an increase in the percentage infestation of bolls in one locality from 1 in September 1938 to 10 in December. Of 3,000 bolls examined late in December, 50 per cent. had been destroyed, but only 3 per cent. of this damage was due to *P. gossypiella* and most of it was consequent on attack by *Argyroploce leucotreta*, Meyr. *P. gossypiella* was very common in mid-September at Bugondo in plots near the ginnery (14 per cent. of the flowers infested), owing to old cotton plants having been left standing.

Some swarms of *Nomadacris septemfasciata*, Serv., were present in July–September 1938 in the Western and Eastern Provinces. Egg-laying took place in the Bugerere area of the Eastern Province in July–August, and the adults of the new generation, which appeared from September, moved westwards to Toro ; in the Teso and Toro districts eggs were laid in October-November, and from January 1939 this species became confined to Toro, where swarms concentrated in April–May in the foothills of Ruwenzori at altitudes of 4,500–8,500 ft. In June, some of them moved into the Belgian Congo, and some northwards to the Lake Albert flats, where they matured and oviposited, but the bulk remained in western Toro, where considerable damage was done to *Eleusine*, maize, banana, beans, cotton, sweet potatoes

and cassava. In October 1938, large numbers of adults were killed in southern Busongora by a fungus that was almost certainly *Empusa grylli*.

The hoppers of *Locusta migratoria migratorioides*, R. & F., in the West Nile Province [*cf. R.A.E.*, A **28** 52] became adult in July 1938; an influx of swarms of this species from the north began in August and continued until February 1939. Breeding, which was widespread throughout Uganda, occurred from October to May ; in April swarms tended to move northwards, which reduced the infestation in central Uganda, but increased it in the north. A southward movement occurred in May, and as swarms matured progressively, there was some additional breeding in May–June in central Uganda. Until January 1939, injury to crops was insignificant, but extensive and serious damage was subsequently caused to *Eleusine*, maize, *Sorghum*, rice and bananas. In some areas, eggs of *Locusta* were parasitised by *Stomatorrhina lunata*, F., while many individuals from swarms in which sexual maturation was delayed contained an unidentified tracheal mite.

TAYLOR (T. H. C.). **Report of the Entomologist, Kawanda.**—*Rep. Dep. Agric. Uganda 1938-39* pt. 2 pp. 9–24. Entebbe, 1940.

An investigation was begun in 1938 on the status of Pentatomids of the genus *Antestia* on coffee [*cf. R.A.E.*, A **24** 648] in small African-owned plots in the Bugishu, Ankole and Kigezi districts of Uganda, in which arabica coffee is now being extensively cultivated. To obtain a basis for comparison, investigations were carried out in May–June and September 1938 in large European-owned estates in a forest area in the district of Kyagwe, where *A. faceta*, Germ., which is almost certainly indigenous in the forest, is the only coffee-feeding species present. It used to be a serious pest in this district, but it has become scarce in recent years, since arabica coffee has been largely replaced by robusta, on which it does not thrive, while most of the remaining arabica plantations are in a neglected state, so that the trees have lanky stems with sparse foliage and frequently form dense growths under old *Hevea* shade-trees, and conditions approach those of a forest. This favours the constant presence of predators and parasites, which are accustomed to shade, absence of wind, high humidity, abundant soil moisture and weed undergrowth that shelters alternate hosts. Test spraying in June showed that the bug was present everywhere, but only 30 per cent. of the arabica coffee was infested, the mean figures per tree being 1·6 for nymphs and adults, and 0·8 for adults only.

Investigations in Bugishu, where arabica coffee is grown in small plots in greatly varying situations at altitudes of 4,500–7,000 ft., showed that the species present was again *A. faceta*, which is probably indigenous in the forests at the lower altitudes. It is usually absent above 6,000 ft., but is gradually spreading higher and occurred in one plot at 6,800 ft. Contrary to the general belief that it multiplies and spreads very rapidly, the author has observed that it is reluctant to move and does not become noticeable in a new locality until it has been present for two years. There was a general decrease in its abundance as compared with 1937, probably because of the reduced crop and the activity of natural enemies, especially egg parasites. The evidence at present available indicates that fluctuations in the

population of *Antestia* will occur periodically, but that severe outbreaks will be rare. The examination of 4,000 coffee berries from various plantations showed that the percentage of completely sound beans considerably increased with higher altitudes, averaging 58 below and 89 above 5,500 ft. and usually exceeding 90 at the higher altitudes where the trees were younger and in much better condition. The percentage of beans damaged by *Antestia* at the lower altitudes is probably at least 30.

In the districts of Ankole and Kigezi, coffee is grown mainly on grassy hills devoid of bush or in open scrub country. Plots of arabica coffee occur at altitudes of up to 6,500 ft., but in recent years robusta has been planted in Ankole, as it is less attacked by *Antestia*. The species concerned is *A. lineaticollis*, Stål, which is present almost throughout the districts, except in two volcanic areas where *A. faceta* occurs. The two species are nowhere found together. The fact that *A. lineaticollis* is present in Ankole practically wherever coffee is grown indicates that it is indigenous in the bush, but no alternate foodplants have so far been found. From the examination of berry samples from test-sprayed plots in 50 localities in Ankole and Kigezi, it is estimated that the percentage of sound beans varied from 61·1 to 93·7. In reality, however, the damage done was greater, as in many plots the trees had been cut back almost to ground level because of the infestation and such plots were not included in the survey.

The value of the commoner control measures is discussed [*cf.* **24** 649]. Regular weekly hand-collection markedly reduces the abundance of *Antestia* and maintains it permanently at a low level. Cutting the trees back is effective, but no crop is obtained for three years and the treatment has to be repeated after six. It has been found, however, that if three adjacent plots of coffee of different ages are stumped in rotation and the trees are not pruned, the plot with the youngest trees, which is the one with the heaviest crop, has much the lowest infestation, because it provides less shelter for the bugs. Spraying with pyrethrum in oil is impracticable in the African-owned plantations. The use of a strong water extract of *Tephrosia vogeli* as a contact or stomach poison and in baits proved completely inadequate.

In observations on the extent to which robusta coffee is attacked, evidence was obtained that *A. faceta* oviposits and can mature on it, but that arabica is certainly preferred. In mixed plantations, all stages of *A. lineaticollis* repeatedly occurred on robusta and there was no evidence of a preference for arabica.

The parasites obtained from *Antestia* in the course of the investigations were, in addition to those already noticed [*cf.* **24** 649], *Microphanurus suranus*, Nixon, *Anastatus bifasciatus*, Boy., an unidentified Eupelmid and a species of *Pleurotropis* (probably a secondary parasite), all of which were bred from the eggs; and the Braconids, *Helorimorpha coffeae*, Brues, and another species of this genus, which attacked the nymphs.

STEPHENSON (P. R.). **Report of the Entomologist, Serere, on Investigations of Cotton Pests.**—*Rep. Dep. Agric. Uganda 1938-39* pt. 2 pp. 24–27. Entebbe, 1940.

This report consists of tables, with explanatory notes, showing the degree of infestation by *Lygus simonyi*, Reut., an unidentified green species of *Lygus*, and *Lygus* nymphs on six varieties of cotton 8, 10

and 12 weeks after sowing, the degree of injury to them 8 weeks after sowing, the degree of infestation of cotton sown at different dates, and the effect of different spacing intervals in the case of different varieties, together with similar data on the effect of different varieties and sowing dates on infestation by Jassids.

Buhl (C.) & Meyer (E.). **Versuche zur Bekämpfung von** *Meligethes aeneus* **Fbr. mit Fanggeräten.** [Experiments with Traps against *M. aeneus*.]—*Z. PflKrankh.* **50** pt. 1 pp. 1–31, 17 figs., 12 refs. Stuttgart, 1940.

A detailed, illustrated description is given of the apparatus designed by the authors for catching adults of *Meligethes aeneus*, F., on rape [*R.A.E.*, A **25** 487], together with an account of large-scale tests in south-eastern Germany in 1937 in which its value was confirmed. The estimated percentages of the beetle populations that were destroyed averaged about 65 for the whole series, and in comparative experiments the apparatus gave better results than several earlier types [*cf. R.A.E.*, A **17** 485]. It should not be used after the plants are in full bloom, since damage by *M. aeneus* is rare after this stage and many honey-bees were destroyed. No mechanical injury was caused to the plants.

Jancke (O.). **Vergleichsversuche mit emulgierten und nicht emulgierten Obstbaumkarbolineen.** [Comparative Experiments with emulsified and non-emulsified Fruit-tree Carbolineums.]—*Z. PflKrankh.* **50** pt. 1 pp. 31–38, 2 refs. Stuttgart, 1940.

In view of differences of opinion in Germany as to whether the tar-distillate spray fluids now known as emulsified fruit-tree carbolineums and previously called Baumspritzmittel [*R.A.E.*, A **24** 797] are as effective as the ordinary medium or heavy oil fruit-tree carbolineums [which are used with emulsifiers that contain soap], the author carried out comparative experiments in 1934–36 at Naumburg. Those with the winter eggs of *Phylloxera vitifoliae*, Fitch, on vines have already been noticed [**25** 763]. The other tests were carried out with *Eriosoma lanigerum*, Hsm., and eggs of *Aphis* (*Doralis*) *pomi*, DeG., on apple, *Lecanium* (*Eulecanium*) *corni*, Bch., and *Hyponomeuta padellus*, L., on plum, and eggs of *Argyresthia ephippella*, F. (*pruniella*, auct.) and first- and second-year larvae of *Coleophora hemerobiella*, Scop., on cherries. Seven of the best known "emulsified" fruit-tree carbolineums and eight ordinary fruit-tree carbolineums, mostly of the medium-oil type, were tested, and the former proved in no way inferior to the latter in insecticidal effect.

Bremer (H.). **Beobachtungen quantitativer Art über das Auftreten von Schäden an Gemüsepflanzen auf dem Versuchsfelde der Zweigstelle Aschersleben der Biologischen Reichsanstalt für Land- und Forstwirtschaft während der Jahre 1929 bis 1935. 1. Mitteilung. Einleitendes. Schäden an Kohl.** [Observations on the Extent of Injury to Vegetables in the Experimental Field of the Aschersleben Branch of the State Biological Institute for Agriculture and Forestry from 1929 to 1935. First Communication. Introduction. Injury to Cabbage.]—*Z. PflKrankh.* **50** pt. 2 pp. 71–84, 1 graph, 9 refs. Stuttgart, 1940.

Since little information is available on the conditions under which injury to vegetables by diseases and insect pests becomes extensive,

observations were carried out in 1929–35 at Aschersleben on the variations from year to year in the numbers of certain pests. In this paper are given the monthly records of temperature and precipitation for all seven years and the results of observations in various seasons on *Hylemyia* (*Chortophila*) *brassicae*, Bch., *Plutella maculipennis*, Curt., and *Phyllotreta* spp. on cabbage.

To ascertain the abundance of *H. brassicae*, the author's method of egg counts [*R.A.E.*, A **17** 634] was adopted, but observations on this species were made only in 1935. Oviposition was found to occur throughout the summer up to mid-September, so that the negligible injury by the summer generations does not necessarily correspond to a decrease in numbers. Most of the eggs were found in soil round the older plants. The only year in which *P. maculipennis* was at all numerous was 1933, when many adults were observed in July, but very little damage was caused.

Phyllotreta spp. were numerous in all the survey years, *P. atra*, F., representing about 95 per cent. of the adults taken. While an increased abundance of *P. atra* was evidently favoured by dry weather, it was always sufficiently plentiful to cause serious injury.

Enser (K.). **Versuche zur Bekämpfung des Apfelblattsaugers in Kärnten.** [Experiments in the Control of the Apple Leaf Psyllid in Carinthia.]—*Z. PflKrankh.* **50** pt. 2 pp. 95–107, 17 refs. Stuttgart, 1940.

Psylla mali, Schm., is a serious pest of apple in the region of the Austrian Alps. In Carinthia, orchards on the slopes up to about 4,600 ft. are infested, though injury there is not so great as in the valleys. Extensive tests of winter sprays for the control of the eggs were made in Carinthia in 1937 and 1938 in heavily infested orchards planted with several varieties of apple. A horse-drawn power sprayer was used, and the sprays were applied when the buds of early varieties were beginning to swell (2nd and 3rd March 1937 and 29th and 30th March 1938).

From the results, which are tabulated, it is concluded that there was a marked difference in the degree of infestation of different varieties of apples. A proprietary heavy-oil fruit-tree carbolineum (Neodendrin) at a concentration of 6 per cent. and an " emulsified " fruit-tree carbolineum (Mixdrin) at 7 and 8 per cent. gave practically complete control. Two proprietary mineral-oil emulsions, each at a concentration of 6 per cent., and normal lime-sulphur gave 73·61, 71·04 and 56·14 per cent. control, respectively. At a concentration of only 5 per cent., Mixdrin was sufficiently effective for practical work against *P. mali*, but was not satisfactory against other pests, such as Aphids and the winter moth [*Operophtera brumata*, L.].

Jancke (O.) & Roesler (R.). **Ueber die Wirkungsart und -Dauer von Berührungsgiften. I.** [On the Mode of Operation and Duration of Activity of Contact Poisons. I.]—*Z. PflKrankh.* **50** pt. 3–4 pp. 134–142. Stuttgart, 1940.

Laboratory experiments in Germany to ascertain the length of time for which contact sprays and dusts retain their effectiveness [*cf. R.A.E.*, A **26** 421] were continued in 1938, the test insects again being second-instar larvae of *Nygmia phaeorrhoea*, Don. (*Euproctis chrysorrhoea*,

auct.). They confirmed that layers of nicotine or pyrethrum dusts lose their effectiveness quicker than those of derris. All the larvae were killed by layers of derris dusts that were 7 days old. One mixture of derris and pyrethrum killed 90 per cent. after 7 days, and another 10 per cent., the difference being due to the higher proportion of derris in the former. Nicotine dusts were noticeably less lethal 2 hours after application and completely inactive after 24 hours. Of two pyrethrum dusts, one was quite inactive after 24 hours and the other after 72.

The dried coatings of spray solutions were less toxic than the dusts, and no mortality was given by coatings that had been dry for 2 hours. With those just dry, 20, 12 and 4 per cent. mortality was given by 1·5 per cent. tobacco extract plus 0·15 per cent. soap, derris and pyrethrum, respectively.

The action of coatings of nicotine on the respiratory system was tested by placing the larvae on wire gauze 1–2 mm. above the coating. It was only while the spray was drying that any effect was produced, and this usually consisted in a stunning or laming of the larvae, though 12 per cent. mortality resulted from 0·5 per cent. crude nicotine plus 0·15 per cent. soap. When the larvae were allowed to feed for 2 days on leaves sprayed 2–3 days previously, crude nicotine and most of the commercial nicotine preparations were insufficiently poisonous, but considerable toxicity was shown by crude nicotine fixed by suitable additions (the nature of which is not stated), tobacco extract similarly fixed, and one commercial preparation. When the larvae were allowed to feed continuously on leaves sprayed 2–3 weeks previously, crude nicotine and tobacco extract with or without any addition, and nicotine sulphate were more toxic than all but one of the commercial preparations.

In a field test, peach trees heavily infested by *Neurotoma nemoralis*, L., were sprayed with 1·5 per cent. tobacco extract and 2 per cent. soft soap when oviposition was nearly completed and the first larvae had begun to feed. No injury to the trees was caused by the spray. Three days after the application, poisoned peach leaves were picked and used to feed unsprayed larvae in the laboratory, coatings 3, 5 and 7 days old being offered. All the larvae died. Other tests proved that they were killed by ingested poison. In the orchard, the spray killed all the eggs and the larvae, including those protected by webbing, that ingested the poison during the weeks following application.

Becker (G.). **Beobachtungen über Schädlichkeit, Frass und Entwicklungsdauer von *Anobium punctatum* De Geer (" Totenuhr ").** [Observations on the Harmfulness, Feeding and Duration of Development of *A. punctatum*.]—*Z. PflKrankh.* **50** pt. 3–4 pp. 159–172, 6 figs., 15 refs. Stuttgart, 1940.

Damage to timbers and wooden furniture, carvings, etc., by Anobiids is common in Germany. The most important species is *Anobium punctatum*, DeG., and in a note on its synonymy, the author points out that the popular name " Totenuhr " (death-watch) is applied to it, whereas the name " death-watch beetle " is applied to *Xestobium rufovillosum*, DeG., in England.

A. punctatum appears to attack all German timbers. The infestation is generally limited to the sapwood, and in oak, ash and *Robinia*, the heartwood is always avoided. In coniferous timbers, the larval mines, which are described, are usually in the spring wood in the

annual rings, but in deciduous woods their course is much more irregular. The pupal chamber is constructed close to the surface of the wood and is free from frass, but the passages from it are full of this material and when the adult gnaws through the thin layer at the end of the exit-hole, some frass comes out round the opening. The presence of much frass round the exit-hole is not necessarily a proof of the emergence of *A. punctatum*, since it is often caused by natural enemies, chiefly the predacious larvae of *Opilo domesticus*, Sturm, which throw out the frass in the mines when seeking the Anobiid larvae. Similar accumulations of frass were caused in one instance by a larva of *Dermestes*.

The number of larvae in a piece of timber may be considerable, and various instances of infestation are described, with particulars of the weights of the larvae. The largest observed weighed up to 12·9 mg. in pine and up to 13·6 mg. in birch. Newly hatched larvae weighed less than 0·005 mg. Larvae of all sizes occur in the same piece of timber, but from the sizes noted at various seasons it is concluded that development indoors requires at least two years and may extend to over three. Larvae weighing more than 6–7 mg. are probably in at least their third year. Under favourable conditions in the laboratory, small and medium-sized larvae doubled their weight in 2–3 months, which suggests that development might be completed in a year, but this can be of only rare occurrence under natural conditions. Pupation takes place in spring, the date depending on temperature. The duration of the pupal stage averaged 14 days at 20°C. [68°F.] and 10 days at 28°C. [82·4°F.], but many pupae died at the higher temperature. The adults appeared from April to July. At 20–22°C. [68–71·6°F.] and a relative humidity of 80–90 per cent., most of them lived for over 20 days and a few for more than 30. No maturation feeding was observed. The duration of the egg stage averaged 19–20 days at 20°C. and 15–16 at 28°C.

The character of the timber seems to have less influence on the larval growth of *A. punctatum* than on that of *Hylotrupes bajulus*, L., but high air humidity is very important, the larvae ceasing to develop if the humidity is too low and dying if this condition continues. In dwelling rooms, humidity is often at or below the critical limit. The temperatures favourable to development are lower than for larvae of *H. bajulus*. Cellars are therefore often favourable, while central heating in many dwelling rooms affords a check. Old timber is less attacked than wood only a few years old.

Moericke (V.) & Winter (G.). **Eine Virose des Blumenkohls in Deutschland.** [A Virus Disease of Cauliflower in Germany.]—*Z. PflKrankh.* **50** pt. 3–4 pp. 172–177, 4 figs., 11 refs. Stuttgart, 1940.

The authors briefly discuss the symptoms of several virus diseases of crucifers that are transmissible to cauliflowers, and describe those of a disease observed in 1938 in the region of Cologne that is probably identical with the cauliflower mosaic recorded from California by Tompkins [*R.A.E.*, A **25** 756]. More or less similar symptoms of mosaic were occasionally seen on Brussels sprouts, savoy cabbage and kohlrabi, the growth of the last-named being seriously affected. On 20th October, when cauliflowers were being harvested, the plants that had shown symptoms of mosaic without stunting had almost

completely recovered, but stunted plants developed very small heads or none at all. The infection apparently occurred after transplanting, and the spread of the virus was probably favoured by a mass increase of Aphids in summer. Dead parasitised examples of *Brevicoryne* (*Brachycolus*) *brassicae*, L., were plentiful on the plants, and some living individuals of *Myzus* (*Myzodes*) *persicae*, Sulz., were observed.

MEUCHE (A.). **Auswinterungsschäden an Oelfrüchten im Winter 1938/39.** [Winter Injuries to Oil-yielding Plants in the Winter of 1938–39.]—*Z. PflKrankh.* **50** pt. 3–4 pp. 177–188, 15 figs. Stuttgart, 1940.

Surveys in the spring of 1939 showed winter injury to oil-yielding varieties of rape in Germany to have been greatest in Mecklenburg, and there chiefly in the north-western portion, including the island of Poel, where all the rape crops had to be ploughed under except for one field. Among the factors responsible is attack by insects, which renders the plants particularly susceptible to injury by winter conditions. Larvae of *Phytomyza rufipes*, Mg., and *Psylliodes chrysocephala*, L., infested the leaf-stems, softening the tissues and rendering them more easily injured by frost, while the subsequent infestation of the plant stem by *Psylliodes chrysocephala* was even more harmful. Decomposition is promoted by the injury caused to the plant stems by larvae of the weevil, *Ceuthorrhynchus picitarsis*, Gylh., the eggs of which were found throughout the winter, so that this species is likely to be more harmful to young plants than *C. quadridens*, Panz., which breeds only in spring. Other insects were of minor importance, though the roots of rape on Poel were severely attacked by the larvae of *Hylemyia* (*Chortophila*) *brassicae*, Bch.

[BOGACHEV (A. V.).] **Богачев (А. В.). Investigations on the Fauna in the Kirovabad Area.** [*In Russian.*]—*Izv. Azerbaidzh. Fil. Akad. Nauk SSSR* **3** pp. 135 137. Baku, 1939. [Recd. 1941.]

Insects collected in the summer of 1938 in an area in western Azerbaijan included a colour form of *Microbracon* (*Habrobracon*) *simonovi*, Kok., a parasite of the cotton Noctuid [*Heliothis armigera*, Hb.], for which the name *lozinskii*, n., is proposed. Investigations in the cotton-growing districts of Azerbaijan showed that this parasite is widely distributed throughout the Kura valley and that there exist several local forms. Thus, the typical form occurs in the steppes on the lower Kura, and f. *lozinskii* in the district of Dallyar. Their life-histories are similar.

[LOZINA-LOZINSKIĬ (L. K.).] **Лозина-Лозинский (Л. К.). An Expedition for the Study of the Ecology of the Cotton Noctuid.** [*In Russian.*]—*Izv. Azerbaidzh. Fil. Akad. Nauk SSSR* **3** pp. 137–138. Baku, 1939. [Recd. 1941.]

Observations in the summer of 1938 on the bionomics of *Heliothis armigera*, Hb. (*Chloridea obsoleta*, F.) on cotton in a district in western Azerbaijan showed that its abundance and rate of reproduction are to a great extent dependent on the presence of nectar-bearing flowers and on the distribution of plants that attract the moths for oviposition.

If the spring and summer are dry, there are fewer flowering plants, they produce less nectar, the female moths consequently live a shorter time, and their fertility is decreased.

It was also found that comparatively few species of wild or cultivated plants are preferred for oviposition and that their attractiveness varies with the different periods of vegetation [*cf. R.A.E.*, A **29** 80], being apparently dependent on the secretion of organic acids, such as oxalic or malic acid. In a completely dark laboratory, the moths readily oviposited on sheets of filter paper moistened with secretions of *Solanum* or dilute solutions of oxalic acid.

Investigations on the fertility of the moths showed that the rapidity of sexual maturation depends on larval nutrition and almost entirely on the quality of the food consumed during the last instar. Feeding on the reproductive organs of a plant, which are rich in albumen, accelerates the development of the larvae and the accumulation of reserves in the fat-body, so that the resulting moths mature rapidly and are able to oviposit without further feeding. Moths resulting from larvae that have fed on the vegetative parts of the plants require supplementary feeding, in which case their longevity and the number of eggs they lay depend not so much on the absolute amount of sugar they consume as on the volume of solution of an optimum concentration.

Outbreaks of *H. armigera* on cotton are due to the coincidence at certain periods in the development of the crop of favourable factors, such as attractiveness for oviposition, the presence of nectar in the flowers and in the extrafloral nectaries, low mortality among the larvae and pupae due to humidity, shade and other favourable microclimatic conditions, and increased fertility of the moths as a result of favourable larval nutrition.

WALLACE (C. R.). **Red-legged Earth Mites. Their Occurrence and Control in New South Wales.**—*Agric. Gaz. N.S.W.* **51** pt. 8 pp. 431–433, 2 figs., 4 refs. Sydney, 1940.

Numerous complaints were received in May, June and July 1940 of damage to plants in New South Wales by soil-dwelling mites. In all cases but one, in which *Halotydeus destructor*, Tucker, was involved, the species concerned was *Penthaleus major*, Dug., infestation by which causes a silvering of the leaves. In peas and clover, whole leaves may appear bleached, while seedlings and young plants, particularly lucerne, are sometimes killed. A study of the collection of the Department of Agriculture showed that whereas *H. destructor* is apparently restricted to parts of the southern tablelands and southern Riverina, *P. major* is widely distributed in the State. It is injurious from mid-May to the end of September, and attacks a wide range of wild and cultivated plants, a list of which is given.

In 1938, a dust of carbolic powder and lime was tested against *P. major* on weedy fallow on which a dense stand of nettle weed (*Lamium amplexicaule*) was uniformly infested. Plots for treatment were scythed and the plants raked away, exposing almost bare soil carrying a heavy population of the mite. The dust, which consisted of 4 lb. hydrated lime and 1 lb. disinfectant powder stated to contain about 12 per cent. carbolic acid (phenols), caused a high mortality of the mites on the soil surface. In 1940, excellent control on a heavily infested

variety of beet was obtained with a spray consisting of nicotine sulphate (1 : 600), 6 fl. oz. emulsified white oil and 5 gals. water, and with a mixture of 1 lb. powdered derris root and 8 lb. of a proprietary nicotine dust containing 2 per cent. nicotine as alkaloid (equivalent to 5 per cent. nicotine sulphate). Adequate control was obtained with a spray containing 4 fl. oz. of a 10 per cent. rotenone solution in benzyl alcohol and 6 fl. oz. emulsified white oil in 5 gals. water; and also with a proprietary nicotine dust thought to contain 5 per cent. nicotine sulphate. The carbolic-lime dust tested in 1938 did not give good coverage of the leaf surfaces and somewhat scorched the foliage. Lime-sulphur spray (1 : 80) without a wetting agent was ineffective [*cf. R.A.E.*, A **23** 150]. The treatments were applied twice at an interval of 13–19 days, but it is considered that a single application might be sufficient for commercial control. The shade temperature usually ranged between 56 and 65°F. The dust of derris and nicotine is particularly recommended for delicate plants, such as lettuce or seedlings, which may easily be scorched.

Insect Pests and their Control.—*Agric. Gaz. N.S.W.* **51** pt. 8 pp. 434–438, 9 figs. Sydney, 1940.

This part of a series on insect pests in New South Wales [*cf. R.A.E.*, A **29** 144] includes notes on the appearance of the fruit-fly, *Dacus* (*Strumeta*) *ferrugineus* subsp. *tryoni*, Frogg., which causes serious loss of fruit in coastal districts of the State, and of several other Diptera that are often confused with fruit-flies by growers, *viz.*, *Pogonortalis doclea*, Wlk., *Lonchaea* sp., *Tapeigaster marginifrons*, Bez., *Sapromyza fuscicornis*, Macq., and *Peronia rostrata*, R.-D. (*Phaonia personata*, Wlk.).

Serious injury to lawns, golf greens and seedlings is caused by the mole crickets, *Gryllotalpa africana*, P. de B., and *G. australis*, Erichs., which tunnel beneath the surface of the soil and feed on roots, organic matter and other insects. They have only one generation a year, and all stages occur together in summer owing to the prolonged oviposition period, which begins in November and continues until autumn. The eggs are laid in batches of up to 200 at the bottom of vertical tunnels about 6 ins. deep, and the nymphs reach maturity during the following spring or summer. The control measures recommended include squirting an irritant contact insecticide such as nicotine sulphate into the tunnels, which forces the crickets to come to the surface, where they can be destroyed; the injection of carbon bisulphide into infested turf at a depth of 4–5 ins. and at the rate of $\frac{1}{4}$ fl. oz. per square ft.; and the use in seed beds of a bait consisting of 20 parts moistened broken rice and 1 part barium fluosilicate, which should either be dug into the soil a few days before planting or broadcast over the surface if the seeds have already been planted.

Various species of *Eucalyptus*, as well as the brush box, *Tristania conferta*, used as a shade and ornamental tree, are attacked by the sawfly, *Phylacteophaga eucalypti*, Frogg. The larva and adults of both sexes are briefly described. The eggs are laid singly under the epidermis of the leaves, and the young larvae feed on the tissues beneath the cuticle. As a result, the leaves become blotched and discoloured and blisters are formed. Pupation takes place in a thin silken cocoon inside the blister, and the pupal stage lasts about a week.

WARD (K. M.) & GROOM (J. L.). **Codling Moth Control. Report on 1938-39 Investigations.**—*Qd agric. J.* **54** pt. 1 pp. 17–37, 2 figs., 19 refs. Brisbane, 1940.

The following is based on the authors' summary. Investigations on the control of the codling moth [*Cydia pomonella*, L.] on apple were continued at Stanthorpe in 1938–39 [*cf. R.A.E.*, A **27** 89, 186] and aimed primarily at testing white oil and nicotine sulphate in cover sprays, determining the value of timing cover sprays according to the abundance of adults, and examining the possibility of timing sprays on a district-wide basis.

In a replicated factorial orchard experiment, six spray mixtures were compared under three different timing schedules. The sprays tested comprised 2½ lb. lead arsenate powder with ¾ lb. casein spreader, 1⅓ gals. white oil, and mixtures of 1, ½, ¼ and 1⅓ gals. white oil with ¼, ½, 1 and 1 pint nicotine sulphate, respectively, all in 80 gals. water. The first five sprays were equally efficient, the differences between them not being statistically significant, but the one containing 1⅓ gals. oil with 1 pint nicotine sulphate gave better control than any of the other treatments. In general, the results supported previous observations and demonstrated that white oil and combinations of white oil and nicotine sulphate are safe substitutes for lead arsenate in cover sprays. They caused much less foliage injury and left no objectionable residues on the fruit.

Sprays timed according to moth abundance as indicated by bait traps tended to give better control than those applied every three weeks, though the difference was not statistically significant. Sprays applied every five weeks gave poor control. Four of the six three-week sprays fell due shortly after peaks of moth activity, and would therefore be as efficient as those timed by traps. There can be little doubt that had spray dates in these timing schedules been more widely divergent, sprays timed by traps would have shown a greater advantage. Laboratory tests of various spray mixtures against eggs of *C. pomonella* showed that white oil is an excellent ovicide, but that nicotine sulphate, lime-sulphur and nicotine sulphate, and potash soap are of little practical value.

Studies of moth behaviour in the field confirmed the previous observation that well-defined peaks of activity, which are associated with moth abundance, occur during the season. Spray applications can therefore be timed according to the activity of the moth, thus avoiding the unnecessary application of sprays and enabling the intensification of spray measures whenever required. It is shown that dates of spray applications in one year do not necessarily bear any relation to those in another. These studies further showed that major peaks of moth abundance develop simultaneously in all parts of the district, but in some localities the moths were sufficiently abundant between the major spring and summer peaks to warrant the application of precautionary sprays. Temperature changes tended to occur simultaneously throughout the district, but some centres were consistently warmer than others. It is concluded that a district-wide advisory service on the timing of sprays against *C. pomonella* is practicable, but would need to be based on observations made at several localities in the district.

Studies in the insectary in 1937–39 showed that the average durations of the preoviposition and oviposition periods, the total egg stage, the

larval feeding stage, and the periods for development from cocooning to pupation and from pupation to emergence were 4·4, 11, 9, 22, 8 and 15 days, respectively.

A review of some recent literature on codling-moth control shows that the principal insecticides employed are lead arsenate, white oil, nicotine sulphate, and nicotine-bentonite preparations. Spray recommendations based on the authors' experiments are given; they restrict the use of lead arsenate to the calyx spray.

Leach (J. G.). **Insect Transmission of Plant Diseases.**—Med. 8vo, xviii+615 pp., frontis., 238 figs., many refs. London, McGraw-Hill Pub. Co. Ltd., 1940. Price £2 2*s*.

One of the objects of this book is to co-ordinate the outstanding contributions to the study of the insect transmission of plant diseases, many of which have hitherto been available only in scattered literature, and to illustrate the general principles of insect transmission. But in view of the importance of the subject as a field of research and the need for close co-operation between entomologists and plant pathologists, which is rendered difficult by their divergent training, the author has extended the scope to cover a wide range of subjects. Rather more than a third is devoted to an account of the etiology of some of the more important insect-transmitted plant diseases caused by bacteria, fungi, viruses and flagellates, and diseases caused by toxic substances produced by the insects themselves, and of the relation of these inocula to insect transmission. Other chapters deal with the inter-relationships between plants and insects; the significance in plant pathology of symbiosis between insects and micro-organisms; various special aspects of the relation of insects to the spread and development of plant diseases; the anatomy and physiology of plants in relation to infection and insect vectors; the anatomy, physiology and feeding and breeding habits of insects in relation to transmission; the importance in this connection of mites, Nematodes and other small animals; and the methods and technique employed in investigation. The transmission by insects of diseases of animals presents similar problems and the findings of medical entomologists have frequently been of value to plant pathologists; brief accounts of some insect-transmitted diseases of animals and a comparison of the phenomena associated with transmission in plants and animals are therefore included.

Hurst (H.). **Permeability of Insect Cuticle.**—*Nature* **145** no. 3673 pp. 462–463, 5 refs. London, 1940.

Wigglesworth (V. B.). **Permeability of Insect Cuticle.**—*Op. cit.* **147** no. 3717 p. 116, 1 ref. 1941.

It is stated in the first paper that workers who have attempted to correlate the toxicity of an insecticide with its chemical and physical properties have failed to attach sufficient physiological significance to the action of the carriers in relation to the toxic principle under investigation. A study of the toxicities to *Cimex lectularius*, L., of constituents of heavy naphtha [a coal-tar distillate used for its control (*R.A.E.*, B **25** 177; **27** 62; **28** 72)] showed that the toxicity of unsaturated compounds may be materially increased by the addition of non-toxic mixtures of paraffins and cycloparaffins. The assumption that the unsaturated compound was assisted through the cuticle by

the more apolar substances present in heavy naphtha led to an investigation of the general physiology and permeability of the insect cuticle. The results show that feebly dissociating compounds of high dielectric constant penetrate the cuticle much more readily in the presence of relatively apolar substances of low dielectric constant, the main region of induced penetration being at the cuticle-haemolymph interface. This applies to both contact and fumigant action. An experiment to illustrate this showed that when a larva of *Calliphora erythrocephala*, Mg., is immersed in ethyl alcohol, penetration through the cuticle and tracheal system is very slow and the insect remains active for at least an hour. The effect of paraffins of the kerosene type is even less pronounced. With a mixture of ethyl alcohol and paraffins, penetration of the alcohol is so rapid that the larva dies within a few seconds, swells perceptibly and bursts within 4–6 minutes. Passage of water from the larva causes a peculiar swirling effect in the region of the cuticle and results in the paraffins being thrown out of solution in the immediate vicinity of the insect and the two components becoming partly separated throughout the volume of the liquid. Mechanical blocking of the spiracles does not materially affect the nature of the results.

The mechanism of penetration has been studied for the cuticles of several species of insects, and an account of this work, together with various insecticidal applications, is to be published. The present work has shown that the thin outer lipoid layer of the insect cuticle is relatively impermeable to polar compounds, but that the inner chitinous layer is relatively permeable to both polar and apolar compounds. The permeability of the lipoid layer to polar compounds is greatly increased by the presence of apolar substances. Thus, when a mixture of ethyl alcohol and paraffins is applied to the cuticle, the polar compound will penetrate the outer lipoid layer and then diffuse into the insect through the chitinous layer, the rate and extent of this diffusion being more pronounced than the diffusion of the water in the reverse direction. The *Calliphora* larvae burst before equilibrium was attained. With any particular mixture, the diffusion is governed by mutual solubilities and the pathological changes occurring in the various tissues. The permeability of the cuticle as a whole to polar compounds is increased in both directions by the presence of apolar substances. The increase is more pronounced in the direction from lipoid to chitin layer than in the opposite direction. The relation between polarity and induced penetration of one or more substances has been worked out for a large number of compounds and applies generally to polar substances of feebly dissociating properties. Induced penetration appears to be negligible for such strongly dissociating compounds as neutral salts and mineral acids. The results obtained are in agreement with the work of Morozov [A **24** 587] and Alexandrov on the permeability of the insect cuticle to various substances acting singly, while Fulton and Howard [A **26** 739] have shown that the toxicity of derris inside the insect may vary with the nature of the oil carrier used.

In the second paper, the author records experiments confirming the view that apolar substances of low dielectric constant greatly increase the permeability of the lipoid layer. When a flea or louse is immersed in oil, minute droplets of water appear all over the cuticle within a few minutes if xylol is used or within half an hour or so if medicinal paraffin or olive oil is used. They are often most marked on the hardest parts. Presumably, polar substances of some kind crowd into the

oil-water interface as the lipoid layer dissolves, and thus draw out the water droplets. If such an insect is immersed in a mixture of ethyl alcohol and kerosene, the droplets swell up and separate with such violence that the insect seems to be effervescing. This is because, in the presence of traces of water, the alcohol separates from the paraffin. A list is given of other mixtures in which the same phenomenon is seen. These observations stress the importance of the partition coefficient of a substance between oil and water in determining the rate at which it will leave the oily base of a contact insecticide and enter the tissues of an insect.

Buckell (E. R.). **The Use of Oil Sprays in Grasshopper Control in British Columbia.**—*Canad. Ent.* **72** no. 8 pp. 149–150. Guelph, 1940.

Since 1935, experiments on the control of grasshoppers by means of oil sprays have been carried out in the Nicola Valley, British Columbia, where many areas are still suitable for the breeding of *Camnula pellucida*, Scudd., and grazing by cattle and loosening of the soil surface by pocket gophers have in recent years created ideal conditions for *Melanoplus mexicanus mexicanus*, Sauss. This method can be used in dull weather, in which hoppers of *C. pellucida* do not readily take bait. The spring of 1939 was dull and wet, and the hatching season protracted. The sprays were applied from two orchard sprayers, of 150 and 300 gals. capacity, mounted on motor trucks and equipped with hoses 50 ft. long and spray guns with No. 5 disk nozzles. Diesel fuel oil was used, at the rate of 7–10 and 15 Imperial gals. to 150 U.S. gals. water against *C. pellucida* and *M. m. mexicanus*, respectively; the oil was emulsified with a commercial casein spreader, using 2 lb. to 150 gals. In this way, hoppers from 44 egg-beds with a combined area of about 80 acres were destroyed, though in one case, owing to repeated hatching, six applications of spray were necessary. The grasshopper campaign of 1939, in which poison bait was used over the main range and oil spray on egg-beds, resulted in complete control over 200,000 acres and prevented a possibly disastrous outbreak.

Although the use of oil sprays is still in an experimental stage, and they can never replace poisoned baits, their judicious application provides a useful subsidiary measure against species such as *C. pellucida*, the eggs of which are concentrated in restricted areas, so that the hoppers are crowded on hatching, or against *M. m. mexicanus*, the hoppers and adults of which congregate on patches of weeds.

Swingle (W. T.), Haller (H. L.), Siegler (E. H.) & Swingle (M. C.). **A Chinese Insecticidal Plant, *Tripterygium wilfordii*, introduced into the United States.**—*Science* **93** no. 2403 pp. 60–61, 7 refs. Lancaster, Pa., 1941.

The powdered root of *Tripterygium wilfordi*, a perennial twining creeper that is widely cultivated in Chekiang, is commonly used by Chinese market gardeners for the control of leaf-eating insect pests of vegetables [*cf. R.A.E.*, A **23** 204; **24** 480; **25** 231; **27** 450], and in 1935 cuttings of this plant were collected in Chekiang and grown in the Plant Introduction Garden at Glenn Dale, Maryland. In preliminary tests, a sample of the powdered root of *T. wilfordi* received from China in the autumn of 1935 was found to have little or no value as a contact

insecticide. A second sample, obtained in the spring of 1936, showed no contact action on larvae of *Laphygma* (*Prodenia*) *eridania*, Cram., *Malacosoma americana*, F., *Bombyx mori*, L., or *Leptinotarsa decemlineata*, Say, and no other action on those of *Laphygma*, but larvae of the other three insects were deterred from feeding on dusted leaves, and those of *B. mori* and *Leptinotarsa* that fed on them died after taking a sufficient dose. This second sample was at least six months old when used, and it is believed in China that the insecticidal value of the powder declines steadily and is entirely lost after a year's storage.

In the autumn of 1939, freshly prepared powder from vigorous plants growing at Glenn Dale was available and proved very toxic to first-instar larvae of *Plutella maculipennis*, Curt., and *Pieris rapae*, L., but it caused relatively low mortalities, and in some instances practically none, to first-instar larvae of *Laphygma eridania*, second and larger instars of *Diaphania hyalinata*, L., and large larvae of *Psara* (*Pachyzancla*) *bipunctalis*, F. Alcoholic extracts gave slightly better results. The material was very repellent to small larvae attacking crucifers, but was less effective than derris on larger ones.

In tests against larvae of *Cydia* (*Carpocapsa*) *pomonella*, L., by the apple-plug method [**21** 338], the powder gave about 60 per cent. uninjured plugs when used at the rate of 2 lb. per 50 U.S. gals. water. An alcoholic extract of the fresh root used at the rate of 2 lb. extractives per 50 U.S. gals. gave 90 per cent. In view of this result, chemical studies of the plant extractives are being made.

HESS (A. D.). **The Biology and Control of the round-headed Apple-tree Borer,** *Saperda candida* **Fabricius.**—*Bull. N. Y. St. agric. Exp. Sta.* no. 688, 93 pp., 36 figs., 30 refs. Geneva, N.Y., 1940.

In view of the severe damage caused to apple trees in New York State by larvae of *Saperda candida*, F., which bore in the trunks, investigations on the bionomics and control of this Lamiid [*cf. R.A.E.*, A **8** 505] were carried out in 1936–38, chiefly in the Champlain Valley. Its distribution is discussed, all stages are described and a list is given of its cultivated and wild food-plants, all of which are rosaceous. Of the former, apple and quince are the most frequently infested, and of the latter, *Amelanchier* spp. and wild seedling apples. In the Champlain Valley, mountain ash (*Sorbus americana*) and seedling apples are more heavily infested than hawthorn (*Crataegus*).

Adult emergence occurs throughout June, reaching a peak about the middle of the month, and ends in early July. The adults are present until the latter part of August. The preoviposition period is usually less than a week. Females usually deposit 30–40 eggs, which hatch in 10–25 days, depending on temperature. The larvae bore in the cambium during the first and second summers, but in the autumn of the second year they usually enter the wood. Most of the larvae reach the sixth and last instar during the second summer, and many of them pupate and give rise to adults in the following spring, thus completing the life-cycle in 2 years. Most of the larvae, however, continue boring in the wood during the third summer and give rise to adults in the following spring, and a few require 4 years to complete the life-cycle. Pupation begins at the end of April and almost all mature larvae have pupated by the end of May. The pupal stage lasts about a month for individuals that pupate early, but only 19 days

later in the season. The adults usually remain in the pupal chambers for about 11 days before emerging from the trees. The eggs are deposited in slits in the bark at about soil level, and, in tests, apple and to a less extent pear, were greatly preferred to *Crataegus*. Most of the females die within 1–2 days after ceasing to oviposit. The adults feed readily on the bark, foliage and fruits of apple, pear and *Crataegus*, and though they do not usually fly more than 10 yards they are capable of covering much greater distances. In one case, it seemed likely that at least one female had flown 225 yards.

The only parasite found in any numbers was the Braconid, *Monogonogastra agrili*, Ashm., which was bred from small stumps containing larvae and pupae of the Lamiid. Three examples of a species of *Microbracon* were reared from a single larva, and three of the Ichneumonid, *Cryptoideus luctuosus*, Prov., from pupae. The larvae and pupae were destroyed by birds, particularly woodpeckers, which extracted them from the trees.

Control measures applied by other workers are summarised in a table. Field experiments in 1937 and 1938 in the Champlain Valley showed that foliage sprays of lead arsenate or cryolite applied to young apple trees are of considerable value against the adults. It is recommended that such trees should receive the same sprays during June and the first part of July as are regularly applied to older trees against the codling moth [*Cydia pomonella*, L.] and other apple pests. If infestation is normal, the first and second cover sprays are the most important for control of *S. candida*, but if wild food-plants are adjacent to the orchards, a third cover spray is advisable to protect the trees from migrating beetles. Spraying the trunks with lead arsenate or cryolite to kill the adults as they emerge through the bark was completely ineffective. Placing wire-gauze screens round young trees and plugging the tops with burlap or cotton forced the females to oviposit above them and so facilitated the detection and removal of the resulting larvae, and also trapped any adults that emerged inside them. Jarring young seedling apples 10 times with a large padded wooden mallet killed all the pupae and young adults in them. Painting the trees with a mixture of calcium cyanide and raw linseed oil killed 73–88 per cent. of the larvae; the treatment was effective provided that the larvae were less than 5 ins. deep in the tree and was shown to be harmless to the trees if proper precautions are taken [*cf.* **20** 293].

In further tests, various insecticides were injected into the larval tunnels in apple trees by means of a new type of gun that proved extremely efficient. All gave good mortalities, and investigations were therefore carried out to determine which were the least injurious to the trees. The materials were injected into holes bored through the bark and were compared with a commercial preparation of paradichlorobenzene (1 gm.) dissolved in carbon bisulphide (1 cc.). Of all the substances tested, the least injurious were paradichlorobenzene and 75 per cent. ethyl alcohol. The latter is apparently a safe diluent for some materials; thus, when 1 part of a 1·5 per cent. rotenone extract was diluted in 4 parts ethyl alcohol, there was a significant reduction in the amount of injury to the trees, as compared with the pure or less diluted extract, and no important decrease in control. Of the materials that caused only slight injury, those that gave the best results, and (in brackets) the percentage mortalities of the larvae, were the mixture of carbon bisulphide and paradichlorobenzene (83–100), dichloroethyl ether (98), pyrethrum extract in alcohol

(78–100) or mixed with ethyl alcohol 1 : 4 (86), 1·5 per cent. rotenone extract with ethyl alcohol 1 : 4 (71) and 5 per cent. rotenone extract in acetone (100).

Other control measures recommended are clean cultivation, which facilitates the detection and removal of the borers and exposes them to natural enemies, the protection of birds, especially woodpeckers, and the eradication of wild food-plants from the vicinity of the orchards.

ELLIOTT (C.) & POOS (F. W.). **Seasonal Development, Insect Vectors, and Host Range of Bacterial Wilt of Sweet Corn.**—*J. agric. Res.* **60** no. 10 pp. 645–686, 2 figs., 10 refs. Washington, D.C., 1940.

A detailed account is given of further work on bacterial wilt of sweet maize caused by *Aplanobacter stewarti* [*cf. R.A.E.*, A **24** 603], including studies on the seasonal development, host range and insect vectors of the bacterium, of which the most important is the Halticid, *Chaetocnema pulicaria*, Melsh. The results are based on records made from 1934 to 1937 at Arlington Experiment Farm (in Virginia, near Washington, D.C.) and for shorter periods at 4 localities in New York, 1 in Indiana and 1 in Ohio.

The following is based on the authors' summary. At Arlington, winter temperatures were well above 32°F. in 1933–34, 1934–35 and 1936–37, adults of *C. pulicaria* were numerous early in the following seasons, and bacterial wilt was abundant and destructive, whereas in the winter of 1935–36 the average temperature was below 32°F., adults of *C. pulicaria* were not plentiful early in 1936, and there was little infection in the early leaf stage. Although infection became general as the season advanced, most of the lesions did not develop beyond local leaf infections and the crop was good. Similar observations were made in the other localities, and it is concluded that the numbers of wilt-infected plants are closely associated with winter temperatures. Where mean winter temperatures are well below 32°F., fewer beetles survive than where they are above 32°F.

During 1934–37, 28,769 insects representing 94 species in 76 genera were tested to determine which species and what proportion of each carry *A. stewarti* internally and may be vectors of the bacterium under field conditions. Tests of 18,613 individuals of *C. pulicaria* during the 4 years indicated that it is the only species of importance in harbouring the bacterium over winter and in spreading it during the growing season. *C. denticulata*, Ill., may possibly play some part in dissemination, but it is not so abundant at Arlington and feeds preferably on *Panicum dichotomiflorum*. Although *A. stewarti* sometimes occurs in abundance in it and it ranks next to *C. pulicaria* in the numbers of adults from which the bacterium was isolated, it is doubtful whether the latter ever overwinters in it. None of the other insects from which *A. stewarti* was isolated is considered a vector of any importance under field conditions. It seems possible for insects casually feeding on maize to pick up *A. stewarti* from infected plants, but the type of culture obtained indicates that such insects do not furnish a favourable environment for the bacterium and are of no importance in its spread.

In the species of *Chaetocnema*, the percentage of beetles infected was usually greater among those caged on infected maize than among those collected from the field. In 1934 and 1935, *A. stewarti* was isolated from 56–68 and 60–95 per cent. of examples of *C. pulicaria* caged on

infected maize and from 48 and 61 per cent. of those of *C. denticulata*. Further proof of the overwintering of *A. stewarti* in adults of *C. pulicaria* was obtained. Seven beetles collected on the 16th March 1936 were fed on maize plants in the greenhouse, and typical wilt symptoms developed. *A. stewarti* was isolated from adults of this species collected at Arlington in every month of the year except February during the four years, and one isolation was made from some collected on the 26th February 1936 at Norfolk, Virginia. Early-and late-season isolations from *C. pulicaria* from other localities have shown that the overwintering adults are more or less infected with *A. stewarti* in all sections of the country in which wilt is prevalent and isolations have been made.

In studies of the host range of *A. stewarti*, *Euchlaena perennis*, *E. mexicana* and *Coix lacryma-jobi* have been found to be susceptible [*cf.* **24** 604], but *Tripsacum* spp. were immune.

FLINT (W. P.), DUNGAN (G. H.) & BIGGER (J. H.). **How to Stop Chinch Bug Losses.**—*Circ. Ill. agric. Exp. Sta.* no. 505, 16 pp., 5 figs. Urbana, Ill., 1940.

An account is given of the bionomics and control of the chinch bug [*Blissus leucopterus*, Say] attacking cereals in Illinois. The control methods suggested include the growing of resistant varieties of maize, the use of barriers [*cf. R.A.E.*, A **23** 464] with post-hole traps along them during the migration of the first-generation nymphs from fields of small grains to maize, and crop rotation in which soy beans and clover are included with maize, which obviates the use of barriers unless small grains have to be grown next to maize. It has also been found that planting soy beans in the hill with maize reduces damage by second-generation nymphs, because the soy beans hold dew and moisture after rain and so make the environment unfavourable for the bug. It slightly reduces the yield of the maize, but the benefit derived more than compensates for this reduction, even if infestation is only moderate.

NORTON (L. B.). **Distribution of Nicotine between Water and Petroleum Oils.**—*Industr. Engng Chem.* Industr. Edn **32** no. 2 pp. 241–244, 3 figs., 9 refs. Easton, Pa., 1940.

The distribution of nicotine between water and oils is of great practical importance in the preparation and use of insecticidal sprays, the behaviour of sprays of nicotine and oil emulsion depending to a great extent on the relative amounts of nicotine in the two phases. Some of the water in the spray mixture runs off immediately after application, and the remainder evaporates in a relatively short time, whereas the greater part of the oil remains on the foliage and serves to hold the nicotine in solution and to retard its loss by evaporation. A distribution of nicotine such that a greater proportion of it was dissolved in the oil phase would therefore tend to extend the period during which it was effective. An account is given of work undertaken to determine the quantitative effect of some of the factors, such as the type of oil, the concentration of nicotine and the presence of other materials in the mixture as insecticides, fungicides and emulsifying agents, that may affect this distribution. It was found that nicotine is

nearly equally distributed between petroleum oils and water at concentrations below about 1 per cent. nicotine, above which the proportion in the water phase increases to 6-7 times that in the oil phase at a concentration of 50–70 per cent. nicotine, decreasing again at higher concentrations. There was practically no difference in the distribution when kerosene was substituted for lubricating oil. Acids extract the nicotine completely into the water phase when present in excess and hold an equivalent amount in the water when in smaller amounts ; the excess free base is left equally distributed between the phases. Alkalies have no appreciable effect in concentrations less than 0·1 normal. In larger amounts they drive the nicotine into the oil phase, the extraction into the oil being complete with 5 N. sodium hydroxide.

It is concluded that in a spray mixture, only nicotine that is added in the free state or that has been set free from a salt by the addition of some basic substance will be shared with the oil, the presence of even a slight excess of a moderately strong water-soluble acid preventing any of the nicotine from dissolving in the oil. Preliminary tests with a number of oil-soluble nicotine compounds showed that, to ensure holding the nicotine in the oil, the compound would also have to be insoluble in water and relatively slightly hydrolysed. Under practically all ordinary conditions, the spray as applied will contain nearly equal concentrations of nicotine in the oil and the water. The ratio will vary little with the type of oil and will be practically independent of the concentration, since the largest amount used in practice is well within the range of constant distribution. It will not be seriously affected by alkaline fungicides, since saturated lime and sodium hydroxide up to 0·1 N. have practically no effect. Emulsifying agents should not produce much change ; in the concentrations used, neither the substances themselves nor their possible hydrolysis products are present in sufficient quantity to affect the solubility of nicotine appreciably. Some of the nicotine originally in the water will be transferred to the oil if the spray dries on the foliage.

ALLEN (T. C.) & CARPENTER (T. L.). **Phytotoxic Properties of undiluted low-boiling Petroleum Oil Distillates.** —*J. econ. Ent.* **33** no. 4 pp. 591–596, 1 fig., 8 refs. Menasha, Wis., 1940.

Recent workers who have carried out tests with atomised sprays of insecticides in highly refined, low-boiling petroleum-oil distillates have given little information as to the toxicity of the undiluted oil to the plants. Emphasis has been laid on the amount of oil applied in relation to injury to plants rather than on its physical and chemical properties. Investigations were, therefore, carried out in Wisconsin in 1938 and 1939 with undiluted petroleum-oil fractions varying in viscosity (expressed as kinematic viscosity in centistokes), degree of refinement (expressed in terms of pounds of fuming sulphuric acid used to treat a barrel of distillate) and source of crude on a number of vegetable crops, to determine the optimum specifications for a non-phytotoxic undiluted petroleum-oil spray. A method of atomising a constant and known amount of distillate on plant foliage in the field is described. It was found that distillates of Midcontinent base crudes were slightly more toxic to plant foliage than distillates of Pennsylvania base crudes of similar refinement ; distillates derived from Midcontinent and Pennsylvania crudes caused relatively little injury when treated with 130 lb. and 100 lb., respectively, of fuming sulphuric acid per barrel

of oil. Fractions having a kinematic viscosity of approximately 1·7 centistokes were the least toxic of those tested; extremely light fractions appeared to cause greater injury than the heavier ones. It was found, however, that a fraction of a Midcontinent distillate treated with 130 lb. acid or of a Pennsylvania distillate treated with 100 lb., with a kinematic viscosity of approximately 1·7 centistokes, could be used safely only when applied at a rate of not more than 5 mg. per square inch of leaf surface.

Ferguson (W. C.). **Certain new Coal Tar Insecticides.**—*J. econ. Ent.* **33** no. 4 pp. 596–600. Menasha, Wis., 1940.

An account is given of tests carried out to determine the insecticidal properties of "heavy-oil dusts" made by mixing low temperature tar oil, as used for dormant sprays [*cf. R.A.E.*, A **27** 535], with talc, and of dusts containing "brown solution" or its derivatives. Brown solution is an aqueous solution containing the alkali-soluble constituents of the higher boiling portion of the coal tar that is made by a patented process of low-temperature carbonisation of partly oxidised coal. It is usually made by treating straight-run soft pitch with sodium-hydroxide solution at about 95°C., at which temperature the pitch is liquid, and removing the brown solution from the pitch by gravity. It contains the soda derivatives of the very mild, phenolic bodies of high molecular weight of the pitch and some colloidally dispersed hydrocarbons and resins. The solution is partly neutralised with sulphuric acid or carbon dioxide until it begins to be cloudy, to remove free sodium hydroxide, concentrated by evaporation until it contains approximately 30 per cent. organic matter and incorporated with an inert powder. "Pitch acids" were precipitated when mineral acids or carbon dioxide was added to neutralised brown solution, and salts of these acids, referred to as "pitchates," when salts or hydroxides of various metals were added. Copper pitchate was obtained in this way by the addition of copper sulphate. The precipitates were washed free of soluble salts, dried and diluted with talc. None of the dusts except the more concentrated heavy-oil dusts injured the plants.

In field tests in Pennsylvania in 1938, dusts containing 0·5 or 1 per cent. heavy oil, 1 or 6 per cent. brown solution or 10 per cent. copper pitchate were as effective against larvae of *Epilachna varivestis*, Muls. (*corrupta*, Muls.) on beans as one containing 0·75 per cent. rotenone and a cryolite dust, the percentage control being about 93 for 6 per cent. brown solution, 95 for the heavy-oil dusts and rotenone and 97 for the other three dusts. Dusts containing 3 per cent. brown solution or 10 per cent. pitch acid gave less than 90 per cent. control. The brown-solution dusts gave better control at lower concentrations of both *E. varivestis* and the potato flea-beetle [*Epitrix cucumeris*, Harr.]. In laboratory tests, dusts containing 1 per cent. heavy oil, or 100 or 10 per cent. copper pitchate or calcium pitchate killed only the younger larvae of *E. varivestis*, possibly by starvation or an irritant effect of the materials rather than by stomach poisoning. All the materials showed some repellency, dusts containing 10 per cent. copper pitchate, 100 per cent. calcium pitchate and 10 per cent. brown solution being the most repellent; dusts containing 0·5 and 1 per cent. heavy oil gave only fair control.

In a preliminary field test in Ohio, single applications of dusts containing 1 per cent. heavy oil, 10 per cent. copper pitchate or 10 per

cent. pitch acid and a dust of pyrethrum and sulphur (0·1 per cent. pyrethrins) gave adequate control of the nymphs of the potato leafhopper [*Empoasca fabae*, Harr.] on beans ; a dust containing 10 per cent. brown solution was less effective.

FERGUSON (W. C.) & DELONG (D. M.). **Low Temperature Tar Oil in Orchard Sprays.**—*J. econ. Ent.* **33** no. 4 pp. 600–610, 6 figs., 6 refs. Menasha, Wis., 1940.

Field and laboratory tests were carried out in Ohio during 1938 and 1939 in a further effort to evaluate emulsions of low-temperature tar oil as dormant sprays for use on fruit trees [*cf. R.A.E.*, A **27** 535]. Oils from low- and high-temperature tars were equally effective against eggs of *Anuraphis roseus*, Baker, and the apple grain aphis [*Rhopalosiphum prunifoliae*, Fitch] on apple in the field when used at a concentration of 2·5 per cent. In one instance, 1·5 per cent. low-temperature tar oil gave adequate control of both Aphids ; this is lower than the minimum successful concentration of high-temperature tar oil recorded in the literature. The addition of 2 per cent. petroleum oil did not affect the value of the tar oils as Aphid ovicides.

A 4·5 per cent. low-temperature tar oil gave about the same control in the field of the eggs of *Paratetranychus pilosus*, C. & F., on apple and peach as a spray containing 2·5 per cent. low-temperature tar oil and 2 per cent. petroleum oil. It was apparent that the tar oil in the latter depressed or counteracted the toxic effect of the petroleum oil against the eggs of the mite, but a spray containing 3·24 per cent. low-temperature tar oil plus 2·16 per cent. petroleum oil gave good control. Thus, it seems that a small addition of low-temperature tar oil depresses the effect of the petroleum oil, but a larger addition of the tar oil adds some potency of its own against the mite. A spray containing 1·7 per cent. low-temperature tar oil plus 2 per cent. petroleum oil gave the most economical control of *P. pilosus* of all the sprays containing tar oil, but it is questionable whether a sufficient factor of safety is present to ensure consistently good control.

In laboratory tests against the eggs of the oyster-shell scale [*Lepidosaphes ulmi*, L.], 4·5 per cent. low-temperature tar oil was significantly better than a high-temperature tar oil of the same concentration. Other sprays giving good control, with no significant difference between them, were combinations of 2·8 per cent. low- or high-temperature tar oil and 3·5 per cent. petroleum oil, and one of 4 per cent. low-temperature tar oil and 0·5 per cent. petroleum oil.

Low-temperature tar oils, when properly emulsified and applied, caused little or no injury to the buds or foliage of apple trees in the dormant or delayed-dormant stage. In fact, in most cases treated trees showed better lateral bud development than untreated trees. No injury was caused to two varieties of peach. Owing to the apparent safety of a properly stabilised heavy-oil emulsion to apple foliage, further investigations of the oil for delayed-dormant purposes is warranted.

Preliminary studies of the oil deposits on plates indicate that Bordeaux mixture (1 : $1\frac{1}{2}$: 100) is sufficient emulsifier to give a safe, fairly slow-breaking emulsion containing 2·5 per cent. low-temperature tar oil. The oil deposit obtained from the various tank-mixed sprays is shown in photographs.

Morrison (H. E.) & Mote (D. C.). **DN Dusts on Hops for Control of the Red Spider.**—*J. econ. Ent.* **33** no. 4 pp. 614–619, 11 refs. Menasha, Wis., 1940.

The damage caused by *Tetranychus telarius*, L., in the United States since it was first reported on the Pacific Coast in 1876 and the measures used for its control are briefly reviewed from the literature. With the growth of the hop industry since 1933, the mite has become an important pest of this crop, and experiments on its control by a single application during the season of a spray or dust were begun in Oregon in 1938. The most effective of the sprays tested was one containing 2 U.S. gals. liquid lime-sulphur, ½ lb. calcium caseinate and 5 lb. dusting sulphur per 100 U.S. gals. water, which, however, gave an average control of only about 60 per cent. A proprietary dust containing 1 per cent. dinitro-ortho-cyclohexylphenol in walnut-shell flour gave practically complete control, but caused slight temporary scorching of one-year-old plants. A mixture of nicotine sulphate, hydrated lime and dusting sulphur, which was the best of the other dusts tested, gave 67 per cent. control. In 1939, more extensive tests of the dinitro-o-cyclohexylphenol dust were carried out in which dosage, compatibility and plant susceptibility were tested in the field. All applications were made when the temperature was not higher than 85°F., unless otherwise stated. Very high kills of *T. telarius* were obtained with the 1 per cent. dust used alone or diluted mechanically with walnut-shell flour to contain 0·75, 0·50, 0·25, 0·125, 0·0625 or 0·03125 per cent. dinitro-o-cyclohexylphenol and applied at the rate of 116–156 lb. per acre. The lowest percentage control (95·9) was obtained with the dust containing 0·125 per cent., which was significantly inferior to the more concentrated dusts (99·5 or more) and also to that containing 0·0625 per cent. (98·7). Talc, hydrated lime, diatomaceous earth, bentonite, Loro [a thiocyanate], nicotine sulphate, pyrethrum and rotenone were compatible with 0·25 per cent. dinitro-o-cyclohexylphenol, but did not increase toxicity. The dust containing diatomaceous earth, which did not penetrate the web or adhere to the foliage, was the least effective. The 1 per cent. dust applied at the rate of 100 lb. per acre at temperatures of more than 100°F. caused no injury to ten varieties of hops, but severely injured two Russian varieties that are not grown commercially in the United States ; when mechanically diluted to contain 0·5, 0·25 and 0·125 per cent. poison it did no damage to four varieties of beans. Promising results in dusting the lower surfaces of the leaves were obtained with an experimental apparatus that applied large amounts of the dust at a low velocity.

Walker (H. G.) & Anderson (L. D.). **Control of the Pea Aphid in eastern Virginia in 1939.**—*J. econ. Ent.* **33** no. 4 pp. 620–623. Menasha, Wis., 1940.

In the spring of 1939, most of the early market garden peas in the Norfolk area matured before *Macrosiphum onobrychis*, Boy. (*pisi*, Kalt.) became injurious, but a very severe outbreak of the Aphid occurred on canning peas on the eastern shore of Virginia when the first pods were beginning to set, untreated peas in several fields being so severely

injured that they were not harvested. Tests were, therefore, made of the comparative effectiveness against *M. onobrychis* of nicotine applied by several different methods and of derris dusts applied with and without a wetting and sticking agent. All the treatments resulted in significant reductions in the numbers of Aphids on the plants and in improvements in yield and quality, but the variation in population on individual plants was so great that there was no significant difference between the treatments for the experiment as a whole. A dust containing derris and talc (1 per cent. rotenone) was less effective than similar dusts containing in addition 1 or 3 per cent. Vatsol OS, between which there was no significant difference. Nicotine vaporised under a trailer, using 3 lb. Vapo-fume liquid containing 86 per cent. free nicotine per acre, and a dust consisting of nicotine sulphate, monohydrated copper sulphate and hydrated lime (10 : 10 : 80), at the rate of 54 lb. per acre, gave higher initial kills of the Aphid than the dusts containing derris, applied at the rate of 40 lb. per acre, but had less residual effect. In a further test, vaporised nicotine, applied at the same rate, gave a reduction of 96 per cent. in the numbers of Aphids on the plants after 3 and 10 days, whereas an oil containing 2 per cent. Vapo-fume liquid and 0·4 per cent. rotenone, applied with an atomiser at the rate of 6 or more U.S. gals. per acre, reduced the numbers by 74 and 77 per cent. after 3 and 10 days, respectively. It appears, therefore, that the atomised spray had little if any more residual effect than the vaporised spray, but it resulted in yields almost as high. Commercial treatment with an atomized oil mixture did not give satisfactory control, owing to the poor coverage obtained, but vaporised nicotine gave uniformly good control. A big power duster gave a more even coating of dust and caused a greater reduction in the numbers of Aphids than a horse-drawn traction duster.

Walter (E. V.) & Brunson (A. M.). **Differential Susceptibility of Corn Hybrids to** *Aphis maidis*.—*J. econ. Ent.* **33** no. 4 pp. 623-628, 1 fig., 3 refs. Menasha, Wis., 1940.

The following is substantially the authors' summary. *Aphis maidis*, Fitch, was more abundant than usual throughout much of the maize belt of the United States during 1938 and 1939, owing to a combination of several factors, including favourable weather conditions and a lack of natural enemies. Observations on 225 inbred and 486 hybrid strains of maize grown in Indiana in 1939 indicate consistent differences between inbred lines in behaviour towards attack by the Aphid. These ranged from the extreme susceptibility of two strains, in which all the plants were infested, to the practical immunity of two others, with no infestation. The severity of infestation and the parts of the plant attacked also varied with the inbred strains, the lower part of the tassels being the most favoured point of attack, and the ear shoots, silks and upper leaves of the more susceptible varieties also being infested. Individual inbred lines differed greatly in prepotency in transmitting susceptibility or resistance to their hybrids. In general, hybrids were less heavily infested than the parental inbred strains, although combinations involving one inbred strain provided a notable exception. No plant character or group of characters was found to be consistently correlated with susceptibility to the Aphid.

Fenton (F. A.) & Fisher (E. H.). **The 1939 Green Bug Outbreak in Oklahoma.**—*J. econ. Ent.* **33** no. 4 pp. 628–634, 6 figs. Menasha, Wis., 1940.

A severe outbreak of *Toxoptera graminum*, Rond., occurred in north-eastern Oklahoma in the spring of 1939, causing an estimated loss of 100,000 acres of small grains. Damage to wheat was first reported on 17th March, and the Aphid increased on barley and wheat until mid-April, when winged forms developed and migrated to spring oats. The infestation on winter barley and wheat declined during the first half of May, and the Aphids rapidly disappeared as the weather grew warmer. By the beginning of June they were difficult to find. The comparative susceptibilities of different small grains to *T. graminum* and the effect of natural controls such as parasites and predators on the development of the infestation were investigated between March and May in widely separated localities within the infested area. A study of climatological data from localities with light, medium and heavy infestations showed no important differences that would account for the variations in population. A heavy total rainfall did not affect the numbers of the Aphid, but it was observed that a heavy, dashing shower lasting about 20 minutes reduced them considerably. Winter barley was more severely damaged than winter wheat, and a much greater percentage of fields under it was infested; most damage occurred on spring oats, but variations were observed in the susceptibility of different varieties. Barley, oats and wheat planted in autumn were much more severely damaged when they followed grain sorghums in a rotation than when they followed soy beans, maize or wheat.

The infestation declined fairly steadily from mid-April until the end of the period of observations, and it was apparent that some factor adverse to multiplication of the Aphids was taking effect. There was no marked trend towards an increase in the production of alate forms during the period. The only parasite observed was *Lysiphlebus testaceipes*, Cress., which occurred in all the fields studied, but not in significant numbers until after the infestation had declined to a low point owing to some other factor or until the plants had been damaged beyond recovery. The most important predacious insect was *Hippodamia convergens*, Guér., the larvae of which were abundant at the peak of the infestation. *Ceratomegilla* (*Megilla*) *maculata*, DeG., and *Chrysopa plorabunda*, Fitch, occurred in the fields but were unimportant; the latter was observed to attack pupae of *H. convergens*. The Aphid was also destroyed by a lizard of the genus *Sceloporus* which did not apparently feed on *H. convergens*.

Guyton (F. E.). **An Outbreak of the Velvetbean Caterpillar in Alabama with Data on Control.**—*J. econ. Ent.* **33** no. 4 pp. 635–639, 1 fig., 6 refs. Menasha, Wis., 1940.

Anticarsia gemmatalis, Hb., has been a minor pest of ground-nuts in Alabama for a number of years, heavy infestations usually appearing too late to do much damage to the crop, but in 1939, when the ground-nut season was a month late, an extensive outbreak was reported on 10th August, a month earlier than the usual infestations. As damage to the foliage continued and became more serious in various parts of south-eastern Alabama, investigations on control measures were begun

on 23rd August in a very heavily infested district. The experimental procedure is described ; dusts were applied with a hand duster at night, as there was a high wind during the day, and the degree of control obtained was estimated by daily comparisons of the number of living larvae on each dusted plot with the number on the control plots. There was little larval migration to the experimental plots until all the surrounding fields had been completely defoliated, when the larvae readily migrated across the protective ditches unless these were in a dust mulch condition. Lead arsenate, applied at the rate of 8 and 10 lb. per acre, gave an average of 90 and 92·5 per cent. control, respectively, and did not scorch wet or dry foliage. Calcium arsenate, applied at the same rates, gave 90·3 and 88·2 per cent. control, but almost always scorched the leaves. The maximum kill from both arsenicals occurred 3-4 days after application. Lead arsenate and calcium arsenate gave 90·7 and 81 per cent. average control, respectively, when diluted with an equal quantity of hydrated lime and applied at the rate of 10 lb. arsenical per acre, but greater dilutions gave unsatisfactory results. Timbo dusts containing 0·5 and 1 per cent. rotenone were ineffective, and poison baits incorporating wheat shorts, spread at the rate of 20–250 lb. per acre, failed to prevent the feeding of the larvae.

The distribution of *A. gemmatalis* in the State in 1939 and its food-plants are discussed. It was a major pest of ground-nuts, soy beans and velvet beans [*Stizolobium*] ; the order in which these crops were attacked varied in different places, but the greatest and most widespread feeding occurred on the leaves and buds of ground-nuts. Kudzu [*Pueraria thunbergiana*], snap beans, cotton, *Sesbania*, lima beans and cowpeas were also attacked. The larvae were very active, feeding both by day and by night, but were much more active on dark days than on bright ones. The adults were active just before dark and on very dark days and were not attracted by lights.

Lincoln (C. G.) & Palm (C. E.). **New Baits for the Control of the Alfalfa Snout Beetle, *Brachyrhinus ligustici* (L.).**—*J. econ. Ent.* **33** no. 4 pp. 639–643, 8 figs., 2 refs. Menasha, Wis., 1940.

This is a progress report on experimental work in 1939 with poison baits for the control of adults of *Otiorrhynchus* (*Brachyrrhinus*) *ligustici*, L., the distribution of which in the United States is limited to two counties in New York [*cf. R.A.E.*, A **25** 179 etc.]. The standard bait containing raisins, shorts and sodium fluosilicate [**19** 528 ; **25** 180] was the best of those tested on both lucerne and ploughed land, but substitute baits were comparable in efficiency. One consisting of 100 lb. maize cobs broken into coarse pieces, 20 lb. sugar, 18 lb. soy-bean flour, 8 lb. sodium fluosilicate and 10 U.S. gals. water, which is cheap and easily spread, is recommended. A bait of 100 lb. bran, 20 lb. sugar, 18 lb. soy-bean flour, 8 lb. sodium fluosilicate and 12 U.S. gals. water compared favourably with the maize-cob bait, but was more difficult to mix and to spread in the wind.

The efficiency of the standard bait was not affected by simulated rain, but that of maize-cob baits was greatly reduced by the equivalent of two inches of rain even after the addition of Karaya gum or animal glue, which reduced the amount of solids washed off by 80–90 per cent. There appeared to be little difference in the rate of kill due to the raisin bait at temperatures of 70–95° F., but there was a marked retardation

in the rate of kill below 70°. Finely ground maize-cobs were inferior to coarser pieces, and there was no significant increase in kill when the amount of sugar was increased from 20 to 40 lb.

HUBER (L. L.). **Effect of the mechanical Husker in Corn Borer Control.** —*J. econ. Ent.* **33** no. 4 pp. 643–644. Menasha, Wis., 1940.

It was at one time assumed that the European corn borer [*Pyrausta nubilalis*, Hb.] would become a serious pest of maize over the whole of Ohio, but it is now considered that it can be important over only a relatively small part of the total maize-growing area of the State. Control by mechanical measures has been replaced by the use of resistant maize hybrids instead of the open-pollinated strains that were common 20 years ago and by slight adjustments in planting dates in a few areas, which will, however, probably become unnecessary with the further development of hybrids for specific areas and for specific purposes. The effect of farming practices, however, is still of interest. In one county in 1939, a large proportion of the maize crop that was formerly cut was picked, no doubt as a result of the development of mechanical huskers. These do not appear to kill or injure more than a very small proportion of larvae during the process of husking, and if their use has any effect on subsequent infestation, it must be to increase it, because they leave the stalks standing in the field. It was estimated that over most of the area that was not cut, the standing stalks would be ploughed under and the land planted with soy beans ; in this case, the destruction of borers would be equal to that caused by cutting. Most of the remainder was to be disked and sown to oats, and over this area there would be increased emergence of *P. nubilalis*. On the whole, however, the mechanical husker does not appear to be an important factor influencing the number of adults of *P. nubilalis* emerging in spring.

NETTLES (W. C.). **Effects of Substitute Crops and Rotations on Wireworm Control.**—*J. econ. Ent.* **33** no. 4 pp. 644–646. Menasha, Wis., 1940.

A severe outbreak of the sand wireworm [*Horistonotus uhleri*, Horn] that occurred in South Carolina during 1938, when it caused severe injury to cotton and maize and some damage to potatoes and tobacco, was probably due to the fact that farmers who previously cultivated alternate halves of the land in successive years planted cowpeas on the land that would normally have grown weeds. It is pointed out that to obtain the maximum control of wireworms, combinations of several practices, of which the most important are crop rotation, the growth of resistant crops, land resting, increasing soil fertility and humus and regulating the planting dates of some crops [*cf. R.A.E.*, A **27** 501], are necessary. Substitute crops will be important in supplying some of the grain and in providing legumes that will permit soil building without increasing wireworm infestations. Good yields of oats were obtained in 1939 in fields in which maize had been severely damaged or completely destroyed in the previous year.

Information on substitute leguminous crops is not yet complete, but it appears probable that *Crotalaria spectabilis* and velvet beans [*Stizolobium*], neither of which showed any injury from wireworms in 1939, may be grown successfully in a rotation and planted as a nurse

crop for oats, instead of cowpeas and soy beans. The great importance of crop rotation in the control of wireworms is discussed. It is emphasised that no single plan is possible, though a two-year rotation will probably suit most farmers in the area.

PARKS (T. H.). **Effect of Wheat Harvesting Machinery on Insect Control.**—*J. econ. Ent.* **33** no. 4 pp. 646–647. Menasha, Wis., 1940.

The substitution of the combine harvester and thresher for the grain binder or header, though satisfactory in the drier areas of the wheat belt of the United States, has some disadvantages during wet seasons in the soft wheat belt of Ohio, Indiana and Illinois. During most seasons, the practice of cutting wheat with the binder and curing it in the shock results in sufficient reduction of the moisture content of the grain to render it satisfactory for storage in farm and elevator bins, but in some seasons, grain harvested by the combine has a high moisture content and is stored under conditions favourable to stored grain pests. The risk is increased by the present policy of maintaining stores of wheat.

Injury by some of the serious field pests of wheat is increased, chiefly owing to the postponement of cutting until the grain is fit to thresh and store and the high cutting of stubble. Allowing the grain to stand until it is thoroughly mature increases losses due to *Mayetiola* (*Phytophaga*) *destructor*, Say, and *Trachelus tabidus*, F., which cause more stems to lodge, so that fewer heads are harvested by the reaper. *T. tabidus* is quite common in 12 counties in north-eastern Ohio. It also involves the risk of losses from grasshoppers in the Great Plain States, where they may cause serious clipping of heads by feeding on the last remaining green portion of the stem just beneath the head at ripening time ; similar but less severe damage may be caused to wheat by *Cirphis unipuncta*, Haw., which, however, causes more injury to barley and rye.

Leaving the straw in the fields creates favourable conditions for the stable fly, *Stomoxys calcitrans*, L., which is of great importance to cattle breeders and dairymen [*cf. R.A.E.*, B **28** 205, 206] and *Harmolita grandis*, Riley, the first-generation adults of which are wingless and cannot return to grain fields if threshing is done at a distance. The use of the combine also increases risk of loss due to *H. tritici*, Fitch, and *H. vaginicola*, Doane, but appears to have no effect on *Blissus leucopterus*, Say, *Toxoptera graminum*, Rond., and *Sitodiplosis* (*Thecodiplosis*) *mosellana*, Géh., and aids the control of *Sitotroga cerealella*, Ol., by reducing the period between harvesting and storing, in which infestation is likely to develop.

BUTCHER (F. G.). **Effect of Idle Land upon Grasshopper Populations.**—*J. econ. Ent.* **33** no. 4 pp. 647–649. Menasha, Wis., 1940.

In North Dakota, summer fallowing of fields is common and may be of considerable use in the control of grasshoppers if it is properly carried out. With careful attention to the timing and type of fallow operations, clean summer-fallow fields provide definite areas that are free of grasshopper eggs and so suitable for the most susceptible crops.

In recent years, agricultural conditions and new agricultural practices have caused a great increase in abandoned and reverted land

in certain areas ; this amounted to nearly 18 per cent. of the total crop land acreage in North Dakota in 1938, and is generally considered to be the cause of the extensive outbreaks of grasshoppers that have occurred during the last few years. Fields that have been out of cultivation for a few years furnish satisfactory conditions for egg deposition by *Melanoplus mexicanus*, Sauss., and species of similar habits, but heavy weed growth for several years results in a considerable amount of trash on the soil surface and a reduction of sunny exposed areas, and therefore renders the ground unattractive for oviposition by these crop-destroying species. As the surface of the soil becomes firmer, and so less favourable for oviposition, and native grass clumps begin to become established, these areas, particularly along the margins, may become favourable for oviposition by such species as *M. differentialis*, Thos., and *M. bivittatus*, Say. The true reverted fields, in which native grasses are becoming well established, are usually less favourable for egg deposition by the typical crop-destroying grasshoppers, but if such fields are overgrazed by livestock or by grasshoppers, large numbers of eggs may be laid. In North Dakota, such fields were frequently observed to be almost uniformly heavily infested during 1938, whereas, after more favourable range conditions during that season, the same fields were relatively lightly infested in 1939.

While the discouraging effect of abandoned land on the farmers and the difficulty of carrying out measures in such sparsely populated country are recognised, it is pointed out that a well-planned control programme, with the participation of the majority of farmers, has given profitable protection of forage crops and a portion of the small grain crop.

WILSON (H. F.). **Lures and Traps to control Clothes Moths and Carpet Beetles.**—*J. econ. Ent.* **33** no. 4 pp. 651–653. Menasha, Wis., 1940.

The observations described, which were made in houses in Wisconsin, show that clothes moths and carpet beetles can be attracted by bait materials, and that fairly heavy infestations can be reduced beneficially. Both pests were attracted into box traps containing cloth pads treated with any dried animal tissue with a strong odour, and the former also to fly-papers treated with various animal substances. In August and September 1937, clothes moths and adults of *Plodia interpunctella*, Hb., and *Tribolium confusum*, Duv., were caught on treated fly-papers. Fly-papers treated with fish meal, sardine oil and cod-liver oil were tested in September and October 1937, and fish meal attracted the greatest number of clothes moths, while cod-liver oil showed no attraction. Larvae of clothes moths and carpet beetles were found in traps baited with fish meal between April and June 1938, and eggs, larvae and adults of clothes moths and larvae of the black carpet beetle [*Attagenus piceus*, Ol.] and the buffalo carpet beetle [*Anthrenus scrophulariae*, L.] between February and October 1939. Between June and October 1939, varying numbers of tapestry moths [*Trichophaga tapetzella*, L.] were caught on fly papers treated with fish meal, cod-liver oil, sardine oil and meat scraps.

A large number of the clothes-moth larvae attracted into the traps were from one-quarter to almost fully grown, and had probably been feeding on the lint in crevices between the floor boards. Most of the carpet-beetle larvae must have come from such crevices, as they were

caught in cupboards containing no woollen materials. The numbers of larvae caught varied with the condition of the floors. Larvae were numerous if the crevices were wide enough to hold large accumulations of lint, and in one floor, in which the lint was closely packed, numerous tunnels made by them were observed.

SMITH (F. F.). **Certain sucking Insects causing Injury to Rose.**—*J. econ. Ent.* **33** no. 4 pp. 658–662, 3 figs., 3 refs. Menasha, Wis., 1940.

In the course of investigations in the eastern United States on insect transmission of mosaic and streak diseases of rose, observations were made between 1932 and 1935 on the behaviour of 44 species of Homoptera and the thrips, *Frankliniella tritici*, Fitch. Most of these were collected on rose, but when placed on leaves or stems, only 10 Jassids, the mealybugs, *Phenacoccus gossypii*, Tns. & Ckll., and *Pseudococcus citri*, Risso, and 4 Aphids bred. The only injuries observed were yellowing by *Carneocephala flaviceps*, Riley, yellowing and necrosis by *Empoasca fabae*, Harr., stippling by *E. maligna*, Walsh, *Erythroneura* sp., and *Typhlocyba pomaria*, McAtee, speckling by *Myzus porosus*, Sand., dwarfing by three of the Aphids and the mealybugs and faint stippling by the thrips. Differential characters of stippling and of faecal deposits are given for identifying the injuries caused by the species of *Empoasca*, *Erythroneura* and *Typhlocyba*. All the insects that caused injury, except *C. flaviceps* and the thrips, were among those that produced offspring on rose.

POTTS (S. F.) & WHITTEN (R. R.). **Further Tests with concentrated Mixtures for aerial Spraying.**—*J. econ. Ent.* **33** no. 4 pp. 676–681, 2 figs., 2 refs. Menasha, Wis., 1940.

The following is taken from the authors' summary of investigations in New Jersey in 1937. In order to determine whether certain concentrated spray mixtures could be successfully applied from the air, and to study the comparative merits of various spreading agents, adhesives, arsenicals and substitutes for arsenicals when applied in concentrates, 22 mixtures were applied to woodland plots from an autogiro [*cf. R.A.E.*, A **27** 645; **28** 182]. Fresh foliage from most of the plots was fed to fourth- and fifth-instar larvae of *Anisota senatoria*, S. & A. The degree of control was determined by comparing the amounts of frass passed by larvae feeding on sprayed and on unsprayed foliage. These foliage samples were taken 1–56 days after treatment, and in all cases the spray residue was sufficient to kill some of the larvae. The arsenical sprays were more toxic than were the organic sprays after the longer periods of exposure. The toxic principles of derris, derris extract, nicotine sulphate, free nicotine and quebracho-fixed nicotine remained on the foliage in effective quantities after an exposure of 2–3 weeks. Non-drying oils and spreaders reduced adherence, but drying oils increased it. Mixtures containing a drying oil, such as fish oil, gave a heavy deposit and good adherence after four inches of rain. Sufficient adherence for most conditions was given by the addition of 0·2 lb. fish oil per 1 lb. arsenical. Certain spreaders increased the atomisation, width of swath and spreading qualities of the mixtures. They facilitated the mixing of the materials

and made possible a considerable reduction in the amount of water required to make a fluid mixture. When a spreader was added, 1½ lb. water per 1 lb. lead arsenate was sufficient for good results.

GAINES (R. C.). **Boll Weevil Control with Calcium Arsenates containing different Percentages of Water-soluble Arsenic Pentoxide.**—*J. econ. Ent.* **33** no. 4 pp. 682–684, 1 ref. Menasha, Wis., 1940.

Tests with calcium arsenates containing different proportions of water-soluble arsenic pentoxide against the cotton boll weevil, *Anthonomus grandis*, Boh. [*cf. R.A.E.*, A **28** 474] were continued in 1939 in South Carolina, Florida, Mississippi and Louisiana. Calcium arsenates containing an average of 0·5, 4·6 and 10·3 per cent. water-soluble arsenic pentoxide, as determined by the New York method, were applied at intervals of about five days, beginning when about 10 per cent. of the squares were found to be infested. Applications were made during the early morning at the rate of 6·5–8·5 lb. per acre. Analysis of the results showed that there were no significant differences between either infestations or yields after the application of the three arsenates, but there were significant differences between treated and untreated plots. There was significant difference between the effects of the treatments in different localities, but none between the effects in different years in any one locality.

GAINES (J. C.). **Tests of Insecticides for certain Cotton Insects during 1939.**—*J. econ. Ent.* **33** no. 4 pp. 684–688, 6 refs. Menasha, Wis., 1940.

During 1939, attempts were made to obtain dusts more effective against *Heliothis armigera*, Hb., and *Anthonomus grandis*, Boh., on cotton in Texas than commercial calcium arsenate, which has so far given the most effective and economical control of these pests. A commercial calcium arsenate containing an intermediate percentage of water-soluble arsenic pentoxide was compared in a latin square arrangement of plots with a specially prepared calcium arsenate with large particles and a high percentage of water-soluble arsenic pentoxide against *H. armigera*, *A. grandis* and the Capsid, *Adelphocoris rapidus*, Say, and in a randomised block with a synthetic cryolite against *Heliothis* and *Anthonomus*. The dusts were applied early in the morning when the cotton was wet with dew, from 23rd July to 9th September in the latin square plots and from 22nd July to 9th August in the randomised block, seven and four effective applications, respectively, being made. The control plots in the latin square were lightly dusted with calcium arsenate against the cotton leafworm [*Alabama argillacea*, Hb.] on 22nd and 29th August.

The three treatments were equally effective against *H. armigera* and gave significant control; the two calcium arsenates were equally effective against *Anthonomus* and significantly better than cryolite, which gave results intermediate between those on the calcium arsenate and control plots; and the special calcium arsenate gave significantly better control of *Adelphocoris* than the commercial one and both were significantly better than the control plot. There were significant differences between the yields from the treated and untreated plots, but none between the different treatments.

In a preliminary test, a mixture of sulphur and calcium arsenate (2 : 1) applied four times in August at the rate of 15 lb. per acre gave about 39, 89 and 61 per cent. control of *A. rapidus*, the cotton fleahopper [*Psallus seriatus*, Reut.] and *Anthonomus grandis*, respectively. *Adelphocoris rapidus* causes injury similar to that due to *Psallus seriatus* and, per individual, is more injurious. As infestations of *Adelphocoris* usually develop late in the season and the population disperse readily, it is difficult to conduct tests under field conditions.

Dahms (R. G.) & Fenton (F. A.). **The Effect of Fertilizers on Chinch Bug Resistance in Sorghums.**—*J. econ. Ent.* **33** no. 4 pp. 688–692, 4 figs., 3 refs. Menasha, Wis., 1940.

The biology of *Blissus leucopterus*, Say, is affected by the resistance or susceptibility of the variety of *Sorghum* on which it develops [*cf. R.A.E.*, A **25** 244], and chemical analysis has shown that susceptible varieties of *Sorghum* are richer in nitrogen than resistant ones. Experiments were, therefore, carried out in Oklahoma in 1937–39 to determine the effect of soil fertility on the resistance of the plants. Plants of a resistant and a susceptible variety were grown in pots in a sandy soil with a low phosphorus and nitrogen but a high potassium content, to which different amounts and kinds of fertilisers were added, and infested with equal numbers of bugs that were collected from several varieties of *Sorghum*. Though the results obtained were somewhat variable, sodium nitrate (16 per cent. nitrogen) appeared to reduce the resistance of both varieties and superphosphate (16 per cent. phosphorus pentoxide) usually increased it. Potassium chloride (40 per cent. potassium) and combinations of two or all three of the fertilisers usually gave inconsistent results with the resistant variety but increased the resistance of the susceptible one. Plants growing in fertile soil without chemical fertiliser and those in manured soil died before the plants grown in sand without fertiliser or manure.

In field tests in 1939, heavy infestations of *B. leucopterus* occurred on both resistant and susceptible varieties of *Sorghum* soon after the plants emerged. All the susceptible plants were killed, but those in soil treated with superphosphate lived longer and were larger before they died than those in untreated soil, and those to which sodium nitrate was applied died sooner. In no case was there complete mortality of the resistant plants, but a larger proportion died in the plots where sodium nitrate was added and a smaller proportion in those that received superphosphate than in untreated plots. There appeared to be no difference in the number of bugs on different plots of the same variety, but there were more bugs on the susceptible than on the resistant variety.

Kerr jr. (T. W.). **Arsenicals for controlling White Grubs in Strawberries.**—*J. econ. Ent.* **33** no. 4 pp. 693–698, 1 fig., 3 refs. Menasha, Wis., 1940.

The following is almost entirely taken from the author's summary. Damage to newly planted strawberries by larvae of *Lachnosterna* (*Phyllophaga*) has been a serious problem in New York State for several years. In investigations in 1938 and 1939, the application of certain sand and arsenical mixtures to the roots of the strawberry variety Premier at planting time resulted in an increase in the percentage of

plants that survived. About 1½ oz. of the mixture was scattered in the hole made in moist soil before placing the plant roots therein, so that the bottom and sides of the hole were covered with a layer of it. In the investigations in 1938 [*cf. R.A.E.*, A **27** 425], where second-year larvae of *L. fusca*, Fröl., *L. anxia*, Lec., and *L. rugosa*, Melsh., were abundant and normal moisture conditions existed, 97·5 per cent. of the plants survived when treated with lead arsenate and sand (1 : 20), while the mean percentage survival of the plants in six control rows was 55·2. In one plot of strawberries in the 1939 investigations, where few second-year and few third-year grubs, including *L. fusca* and *L. anxia*, were present and where a slight drought existed, the percentage survivals of plants treated with mixtures of sand and magnesium arsenate (1 : 50), lead arsenate (1 : 50), lead arsenate (1 : 20) and magnesium arsenate (1 : 10) were 97·7, 97·3, 95·4 and 93·2; 87·5 per cent. of untreated plants survived. In another plot where third-year larvae of unknown species were abundant and conditions of extreme drought existed, 92·4 and 90·2 per cent. of plants treated with magnesium arsenate and lead arsenate (1 : 20), respectively, survived as compared with 67·1 per cent. of untreated plants. Mixtures of zinc arsenite, zinc arsenate or calcium arsenate and sand were extremely injurious to the strawberries. Arsenic-free ground glass and an aqueous mixture of mercurous chloride and gum arabic, poured into the hole in which the plant roots were placed, were both ineffective in preventing injury to the roots. Maximum grub injury occurred between 18th and 28th July in 1938 and between 19th and 29th July and between 10th May and 6th June in the two plots in 1939.

The mixture of lead arsenate and sand (1 : 20) appears to retard the growth of the strawberry plants, but the retardation seems to be temporary. Analyses of the fruit from plants treated with lead arsenate or magnesium arsenate indicate that there is no increase, either in lead or arsenic, over the amount normally present in strawberries.

Fulton (B. B.). **The Blueberry Bud Mite, a new Pest.**—*J. econ. Ent.* **33** no. 4 p. 699. Menasha, Wis., 1940.

Injured buds of the cultivated blueberry [*Vaccinium*], collected in south-eastern North Carolina and received by the author in March 1939, were found to be infested beneath the bud scales with large numbers of the mite recently described by H. H. Keifer from other specimens taken in the same locality as *Eriophyes vaccinii*, sp. n. [*Bull. Dep. Agric. Calif.* **28** no. 5 p. 329. 1939]. It was associated with a galled condition of the plant tissue, which was stated to have been first observed in the spring of 1938 and to have become more serious in 1939, when about a quarter of the buds failed to develop and another quarter showed some injury. The mites were very scarce in the summer of 1939, but their numbers increased with the formation of winter buds in the autumn. Both mites and eggs were found throughout the winter, mainly under the large outer bud scales, with a few under the short basal scales and practically none deeper in the bud. In early spring, when the blossom buds began to expand, the mites penetrated into the interior of the bud and lived among the developing blossom clusters, many of which did not bloom, while others produced a few flowers; berries that developed from infested buds had a warty surface. Mites did not occur inside the corolla, but were numerous

between the corolla and the calyx cup, where they might be picked up by the feet of bees ; their spread was too rapid to be accounted for by their own movement. In one locality, the mites were also found on wild blueberry.

CARTER (R. H.). **The titratable Acidities and pH Values of Cryolite Insecticides.**—*J. econ. Ent.* **33** no. 4 p. 699, 2 refs. Menasha, Wis., 1940.

In continuation of work in the United States on natural cryolite and synthetic cryolite of home and foreign manufacture [*cf. R.A.E.*, A **28** 171], the titratable acidities and pH values of a number of samples of each class were determined by a procedure that is described. The ranges for samples of the first two classes are given, and the individual figures for 15 samples of foreign synthetic cryolite are shown in a table ; the titratable acidity of the latter varied considerably, and the pH values were, for the most part, much lower than those of the other classes. Acidity may be partly responsible for the scorching of the plants that sometimes follows the application of cryolite insecticides, but two of the foreign samples have been found to cause excessive scorching when used on such vegetation as beans, peas, maize, cotton and groundnuts, while others with a greater titratable acidity have not been recorded to have caused scorching.

EAGLESON (C.). **Fire Ants causing Damage to Telephone Equipment.**—*J. econ. Ent.* **33** no. 4 p. 700, 2 figs. Menasha, Wis., 1940.

Damage to telephone equipment by ants has occurred between May and October for several successive years at Galveston, Texas, and during September 1939, 83 out of 446 cases of failure in substation equipment were due to ants, which were identified as *Solenopsis geminata xyloni*, McCook. The failures were due to the fouling of the working parts by the ants themselves, the removal of portions of the insulation on wires, causing short circuits, and the introduction of lint, fibres and food particles, which foster excess humidity and consequent corrosion of metal parts, in the course of nesting. Damage caused to two pieces of apparatus is illustrated and described. Further trouble was experienced with fouled lightning protectors, in which an accumulation of dead ants and particles of foreign matter between the metal contacts holding the arrestor blocks was sufficient to earth the line during humid weather.

WATKINS (T. C.). **Light Trap for counting or collecting Leafhoppers on Lettuce Plants.**—*J. econ. Ent.* **33** no. 4 p. 701, 1 fig. Menasha, Wis., 1940.

The base of the trap described is a truncated cone of galvanised iron large enough to cover a lettuce plant and having a sleeved opening at the side through which the arm can be inserted. To the top of the cone is cemented a smaller one of transparent celluloid having the inverted screw top of a glass preserving jar cemented to its open apex. The trap is placed over a lettuce plant, a glass jar is quickly screwed on to the top, and the plant is then brushed gently so that the leafhoppers fly into the jar. The trap should be used in bright sunny weather and as near mid-day as possible.

Jones (S. C.). **Dichlorethyl Ether as a Means of Control for Pear Thrips.**—*J. econ. Ent.* **33** no. 4 p. 703. Menasha, Wis., 1940.

Preliminary experiments were carried out in Oregon in the spring of 1939 to determine the value of dichlorethyl ether as a soil insecticide for the control of the pear thrips, *Taeniothrips inconsequens*, Uzel. A mixture of 10 cc. dichlorethyl ether and ½ gm. Vatsol in 1 U.S. gal. water was applied to moist soil in two orchards at the rate of 1 U.S. gal. per sq. yard. No thrips emerged from the treated soil, whereas several thousand emerged from a few square yards of adjacent untreated soil between 22nd March and 2nd April.

Ritcher (P. O.). *Cyclocephala immaculata* **Oliv. as a Test Insect.**—*J. econ. Ent.* **33** no. 4 p. 704, 2 refs. Menasha, Wis., 1940.

In the course of a recent study of the bionomics of the Dynastid, *Cyclocephala immaculata*, Ol., it was found that the adults do not feed and that they can easily be reared in winter from third-instar larvae collected in the field. Experiments were therefore carried out to ascertain whether larvae could be obtained from them in winter for use in tests of soil insecticides. Third-instar larvae, collected behind the plough in Kentucky on 10th November 1939 were stored in an unheated greenhouse, and some of the larvae were transferred to boxes containing moist, sifted soil and several kernels of wheat on 9th December or 26th January and kept at higher temperatures. The adults were transferred one or two days after they emerged to gallon tins half filled with packed, moist, sifted soil for oviposition, and the eggs were obtained by sifting the soil every other day. They were placed in individual cavities in moist, packed soil and covered with moist, sifted soil when the mandibles of the developing larvae showed through the chorion.

The first adults emerged on 27th January from material kept at 73°F. from 9th December to 9th January and then at 82°F., and oviposition occurred between 8th and 28th February, when 11 females laid an average of 28·8 eggs each. The corresponding dates were 5th February and 18th February–4th March for material kept at 73°F. from 9th December onwards, and 5th March and 17th March–1st April for material kept in the greenhouse until 26th January and then at 80°F. The incubation period was 12–15 days at 83°F. and 18–22 days at 73°. The first larval instar lasted 22 days for five individuals at 80°F., and the second 25 days for one and about 28 days for another.

It is not known whether the insect can be bred continuously under artificial conditions, but a constant supply of eggs and small larvae, which is the most important requisite for a test insect, can be obtained by collecting larvae in the third instar during autumn, keeping them at 40–45°F., and transferring small numbers to moist earth with wheat at higher temperatures at sufficiently frequent intervals.

Bailey (W. K.) & Plank (H. K.). **An Agromyzid Fly infesting Sweetpotato Seed in Puerto Rico.**—*J. econ. Ent.* **33** no. 4 pp. 704–705, 4 refs. Menasha, Wis., 1940.

Flies taken on sweet-potato flowers in Porto Rico and bred from puparia found in sweet-potato seeds in the spring of 1938 were identified as *Agromyza coerulea*, Mall., the food-plants and distribution

of which are briefly reviewed. The larva entered the seed near its point of attachment to the placenta at the base of the capsule and pupated in a small hole eaten out of the seed. Frequently, when a capsule contained two seeds, the puparium extended into both. Sweet-potato flowers open early in the morning, close during the afternoon and usually drop off on the following day. It was found that infestation of a capsule seldom occurred if the flower from which it developed was protected from insects on the day it was open, the average percentage of capsules of 5 varieties of sweet potato infested being 1·7 when the flowers had been protected and 13·5 when they had not. It appears, therefore, that *A. coerulea* would not be a factor in a breeding programme, in which the flowers must be protected for pollination control.

Studies of aerial Activities of Insects.—*J. econ. Ent.* **33** no. 4 p. 710. Menasha, Wis., 1940.

Insects caught at high altitudes on traps attached to aeroplanes in Louisiana and Mexico [*cf. R.A.E.*, A **19** 634; **28** 79] included boll weevils [*Anthonomus grandis*, Boh.] at 2,000 ft., spotted cucumber beetles [*Diabrotica duodecimpunctata*, F.] at 3,000 ft. and leafhoppers at 13,000 ft. Mosquitos were found as high as 5,000 ft., and the pink bollworm [*Platyedra gossypiella*, Saund.] even higher, while wingless forms, including ants, spiders and mites, were taken at all elevations up to 15,000 ft. Captures were often made at apparently considerable distances from the place of origin of the insects, and the studies demonstrate that insects may spread long distances by means of air currents.

Pests and Diseases.—*Rep. Dep. Agric. St. Lucia 1939* pp. 25–28. St. Lucia, 1940.

Investigations on pests of *Citrus* in St. Lucia were continued by R. C. Fennah in 1939 [*cf. R.A.E.*, A **28** 321–322], and the results are summarised by him. Considerable control of *Diaprepes* spp. was exercised by the indigenous parasites, *Tetrastichus* sp. and *Ufens* sp.; 62 per cent. of the egg-masses collected and over 50 per cent. of the eggs in each of these masses were parasitised. The cultivation under *Citrus* of *Tephrosia candida*, a cover crop that is avoided by the weevils, was undertaken on a large scale on some estates, and excellent stands were established, while the system of protecting the main roots of *Citrus* by removing the soil and leaving them permanently exposed [*cf.* **26** 403] was adopted with good results by some growers. In cases of severe attack on secondary roots, it is recommended that the soil round them should be excavated, mixed dry with lead arsenate at a rate of about 1 lb. per 10 cu. ft., and then tamped back into place. In the course of work on Coccids, particularly *Coccus viridis*, Green, *Lepidosaphes beckii*, Newm., and *Pinnaspis minor strachani*, Cooley, in a *Citrus* nursery, it was observed that *C. viridis* disappears from *Citrus* placed under heavy shade; that in the open field or under moderate shade all scale attack is avoided or thrown off by healthy plants with an adequate functional root system; and that heavily infested plants with a poor root system do not benefit from water, shade or fertilisers.

In June and July, Coccinellids, including *Cryptognatha nodiceps*, Marsh., *C. simillima*, Sic., *C.* (*Delphastus*) *flaviceps*, Crotch, *Pentilia egena*, Muls., and *Azya trinitatis*, Marsh., were introduced from Trinidad against the coconut scale, *Aspidiotus destructor*, Sign. Two consignments of adults of *Metagonistylum minense*, Tns., were sent from St. Lucia to St. Vincent [against *Diatraea saccharalis*, F., on sugar-cane]. A list is given of about thirty pests of garden crops identified during the year, showing the plants on which they were taken.

HAYWARD (K. J.). **El "herrumbre" o "tostado" de las frutas cítricas.** [The Rust of *Citrus* Fruit.]—*Circ. Estac. exp. agríc. Tucumán* no. 89, 8 pp., 2 figs., 2 refs. Tucumán, 1940.

The information in this paper on the bionomics and control of *Phyllocoptruta* (*Phyllocoptes*) *oleivorus*, Ashm., which attacks *Citrus* in Tucumán and in other provinces of northern Argentina, is largely taken from a paper already noticed [*R.A.E.*, A **19** 86].

GLOVER (P. M.). **Entomological Section.**—*Rep. Indian Lac Res. Inst. Namkum 1938–39* pp. 22–31. Ranchi, 1939. [Recd. 1941.]

The Coccid, *Aonidiella* (*Aspidiotus*) *orientalis*, Newst., continued in 1938–39 to be a serious pest of *Zizyphus jujuba* and *Schleichera trijuga*, which are used as host trees for *Laccifer lacca*, Kerr, at Namkum (Bihar), but satisfactory control was given by the petroleum distillate used in the preceding year [*R.A.E.*, A **27** 128]. Adults and nymphs of the Pentatomid, *Tessaratoma javanica*, Thnb., were very abundant on *S. trijuga* from May to September, but by the middle of September the outbreak was completely under control, chiefly owing to hand collection and parasitism of the eggs by two Chalcidoids, one of which was identified as the Eupelmid, *Anastatus colemani*, Crwf. Other natural enemies identified during the year comprised *Rodolia breviuscula*, Weise, predacious on *Icerya aegyptiaca*, Dgl., on *S. trijuga*, the Braconid, *Disophrys sissoo*, Wlkn., and the Tachinids, *Tachina* (*Eutachina*) *civiloides*, Baranov, and *Dolichocolon rufescens*, Baranov, which parasitise the Noctuid, *Pandesma quenavadi*, Gn., on *Acacia catechu*, and the Tachinid, *Sturmia macrophallus*, Baranov, from the Geometrid, *Semiothisa fidoniata*, Gn., also on *A. catechu*. Ornamental *Hibiscus* was for the first time seriously injured by the Curculionid, *Desmidophorus hebes*, F. Hand collection was a simple method of control.

The 17th generation of the parthenogenetic strain of *L. lacca* [*cf. loc. cit.*] matured in July and the 18th in October. The 19th generation was developing normally in March 1939.

The Noctuid, *Eublemma amabilis*, Moore, and the Tineid, *Holcocera pulverea*, Meyr., continued to be the chief natural enemies of *L. lacca*, and were the only predators of it that occurred. The average monthly percentage parasitism of *L. lacca* was again 7·5, with a maximum in March. Parasites bred from it during the year comprised the Eupelmid, *Eupelmus tachardiae*, How., the Encyrtids, *Tachardiaephagus tachardiae*, How., *T. t. somervilli*, Mahd., *Parechthrodryinus clavicornis*, Cam., and *Erencyrtus dewitzi*, Mahd., the Aphelinids, *Coccophagus*

tschirchii, Mahd., and *Marietta javensis*, How., and the Eulophid, *Tetrastichus purpureus*, Cam. The average monthly percentage hyperparasitism was 4·2.

Parasitism of the larvae of *E. amabilis* by *Microbracon greeni*, Ashm., averaged 11·5 per cent. No satisfactory laboratory host for the mass breeding of this Braconid was found. Following laboratory observations that it oviposits only when supplied with sugar solution [*cf.* **27** 128], investigations showed that females fed on the honeydew secreted by *L. lacca* oviposited freely ; this is probably the source from which they obtain the necessary sugar in the field. In work on the relationship of *M. greeni* and *M. lefroyi*, D. & G. [*cf.* **27** 575], females of the latter caged with males of the former did not oviposit, and females of the former caged with males of the latter gave rise to males only.

M. hebetor, Say, continued to breed satisfactorily in *E. amabilis* and *H. pulverea* in the laboratory throughout the year, and *Plusia peponis*, F., a Noctuid that attacks snake gourd [*Trichosanthes anguina*], and the Tineid, *Porthmologa paraclina*, Meyr., which infests *Z. jujuba*, were shown to serve as alternate hosts of it. *M. hebetor* was also bred from larvae of the wild rock bee, *Apis dorsata*, F., which were parasitised in the laboratory. Females of *M. hebetor* and *M. greeni* occasionally oviposit on the same host, and where not more than 4 eggs occur, adults of both Braconids may emerge. A list is given of minor parasites of *E. amabilis* and *H. pulverea* observed during the year. They include *Chelonus* (*Chelonella*) *cycloporus*, Franz [which was described from *H. pulverea* (*cf.* **19** 11)].

Of the Trichogrammatid egg parasites reared in 1937–38 [**27** 129], the first and third were identified as *Trichogrammatoidea nana*, Zehnt., and the second as *Trichogramma minutum*, Riley [*cf.* **28** 204]. In the field, *Trichogrammatoidea* appears to attack the eggs of *E. amabilis*, *H. pulverea* and the Lycaenid, *Tarucus theophrastus*, F., only from July to March ; it presumably breeds in the other months on an alternate host. The total percentage parasitism of 7,948 eggs of these three hosts and of *Ephestia* sp. offered to 178 females was 24·7 ; adults were bred from 93·2 per cent. of the parasitised eggs, and the percentage of females among them was 49·8. The life-cycle required from one to three weeks, and the average adult longevity was 1·6–5·4 days for males and 3·1–9·9 days for females ; adults survived longest in December. *Trichogramma minutum* has been observed in the field from April to October. Males and females completed their life-cycles in 6·16 and 7·12 days and survived for averages of 1·7–2·9 and 2·4–3·3 days, respectively. The total percentage parasitism among 6,996 host eggs, including those of *E. amabilis* and *H. pulverea*, offered to 184 females was 36. Adults were bred from 88·7 per cent. of the parasitised eggs, and the percentage of females among them was 67·1.

Glover (P. M.). **Entomological Section, 1939-40.**—*Rep. Indian Lac Res. Inst. Namkum 1939–40* pp. 17–24. Ranchi, 1940.

As a result of systematic control, *Aonidiella* (*Aspidiotus*) *orientalis*, Newst., was for the first time of no appreciable importance as a pest of host trees of *Laccifer lacca*, Kerr, at Namkum in 1939–40, and the Pentatomid, *Tessaratoma javanica*, Thnb., was also less numerous on *Schleichera trijuga*. The 19th generation of the parthenogenetic strain of *L. lacca* [*cf.* preceding abstract] matured in July, and the 20th

generation, which was inoculated on a fresh plant, developed normally until the plant died, owing to termite attack. A new strain was started in October 1939. The percentage parasitism of *L. lacca* for the year averaged 6, the parasites bred being the same as in 1938–39 [see preceding abstract]. Hyperparasitism amounted to only 3·2 per cent.

Eublemma amabilis, Moore, and *Holcocera pulverea*, Meyr., continued to be the major enemies of *L. lacca* and were the only predators observed. Laboratory breeding of the Braconids, *Microbracon greeni*, Ashm., and *M. hebetor*, Say, on a large scale was carried out successfully. Investigations on the possibility of collecting larvae of *E. amabilis* and *H. pulverea* when they are abundant and keeping them at low temperatures for the subsequent breeding of these parasites showed that larvae of *E. amabilis* survive longer at 10°C. [50°F.] than at 20°C. [68°F.], but larvae kept at 10°C. were useless for breeding purposes. They could, however, be kept for over a week at 20°C. and were then still suitable as hosts, particularly for *M. greeni*. Larvae of *H. pulverea* withstood low temperatures much better and were suitable as hosts for *M. hebetor* whether maintained at 10 or 20°C. Parasitism of larvae kept for 3 weeks at 10°C. and the rate of breeding from eggs laid on them compared favourably with the results obtained with control larvae. In an experiment on biological control, adults of *M. greeni* were released against *E. amabilis*, and of *M. hebetor* against *E. amabilis* and *H. pulverea*. The results as regards *M. hebetor* are considered promising.

Breeding of the two Trichogrammatids was continued. *Trichogrammatoidea nana*, Zehnt., parasitised the eggs of *E. amabilis* and *H. pulverea* in the field in July–August and December–January, and *Trichogramma minutum*, Riley, was observed parasitising the eggs of *E. amabilis* for the first time in the field in August. In the laboratory, it parasitised the eggs of *E. amabilis*, *H. pulverea* and *Ephestia* sp. and also bred satisfactorily in eggs of an undetermined species of Lepidoptera on *Cassia fistula*. A list is given of the minor parasites of *E. amabilis* and *H. pulverea*, which were the same as in the preceding year.

MARSHALL (Sir G. A. K.). **New Indian Curculionidae (Col.).**—*Ann. Mag. nat. Hist.* (11) **7** no. 38 pp. 184–195. London, 1941.

Ten new species of weevils are described from India and a new genus, *Pempherulus*, is erected with *Pempheres affinis*, Faust, the Indian cotton-stem weevil, as the type. Among other species transferred to *Pempherulus* is *Phylaitis pterospermi*, Mshl. [*R.A.E.*, A **13** 349]; *P. scutellaris*, Mshl. [*loc. cit.*] is placed in the genus *Chirozetes*.

PRUTHI (H. S.). **Descriptions of some new Species of *Empoasca* Walsh (Eupterygidae, Jassoidea) from North India.**—*Indian J. Ent.* **2** pt. 1 pp. 1–10, 2 pls., 8 figs. New Delhi, 1940.

Descriptions are given of the adults of both sexes and the male genitalia of the following new Jassids: *Empoasca solanifolia* on potato; *E. minor* on grape-vine and cotton; *E. binotata* on artichoke, brinjal [*Solanum melongena*], bhindi [*Hibiscus esculentus*], cucurbits, lucerne, cowpea, berseem [*Trifolium alexandrinum*], *Cajanus cajan*

and mustard ; *E. punjabensis* on potato, tobacco, tomato, *S. melongena*, *Zinnia*, cotton, guava, safflower [*Carthamus tinctorius*], bajra [*Pennisetum typhoideum*], carrot, bean, lucerne and *T. alexandrinum* ; *E. tabaci* on tobacco ; *E. parathea* on soy bean, *S. melongena* and castor [*Ricinus communis*] ; *E. kerri* on castor and maize ; and *E. kerri* var. *motti* on flax, cowpea, castor, potato, cotton and other plants.

Ullah (G.). **Studies on Indian Aphididae. I.—The Aphid Fauna of Delhi.**—*Indian J. Ent.* **2** pt. 1 pp. 13–25, 11 figs., 14 refs. New Delhi, 1940.

Aphids collected during a survey in the Delhi area included 17 species in 9 genera. Notes are given on the diagnostic characters of each genus and on the distribution and economic importance of each species in India and in other parts of the world. Those that cause considerable damage to crops in the Delhi district include *Rhopalosiphum pseudobrassicae*, Davis, on crucifers, tobacco and potato ; *Macrosiphum solidaginis*, F., on safflower [*Carthamus tinctorius*] ; and *M. avenae*, F. (*granarium*, Kby.), which in some years is a serious pest on wheat and barley, but is controlled by Syrphid larvae and Coccinellids, and also occurs in small numbers on oats, maize and *Sorghum*. *Brevicoryne brassicae*, L., attacks crucifers, especially cabbage, cauliflower and radish, from November until May, but is not generally a serious pest. *Aphis gossypii*, Glov., occurs on a large number of crops, but is not very injurious ; cotton escapes injury because this Aphid does not appear until rather late in the season. *A. maidis*, Fitch, occurs on many graminaceous plants, but does not normally feed on sugar-cane in Delhi. *Toxoptera graminum*, Rond., occurs sparingly on wheat, barley and *Sorghum* from February to April. No sexual forms of any species were observed, and reproduction is entirely parthenogenetic.

Husain (M. Afzal) & Khan (M. Haroon). **Studies on *Platyedra gossypiella* Saunders in the Punjab. Part IV. Relative Incidence on Exotic and Indigenous Varieties of Cotton.**—*Indian J. Ent.* **2** pt. 1 pp. 45–57, 4 figs., 24 refs. New Delhi, 1940.

Since some varieties of cotton appear to be more susceptible to infestation by *Platyedra gossypiella*, Saund., than others, the relative infestation of the chief native and American varieties grown in the Punjab was investigated there during 1931–33. Examination of collections of green bolls from adjacent plots under native and American cotton and from small numbers of plants of native and American varieties grown together in cages in which moths were released, the results of which are given in detail, showed that the American varieties were more heavily attacked than the native ones, the difference being more marked when the incidence of infestation was high. The mean ratio between the percentages of bolls attacked on American and native cotton was found to be statistically significant.

Since intensity of attack by *P. gossypiella* is correlated with climate [*R.A.E.*, A **24** 763], the difference in susceptibility between different varieties of cotton may be partly due to differences in the microclimates produced by their varying habits of growth. American cotton plants, which are shorter and more spreading and have broader leaves than the native varieties, produce rather more shade. The

results of the cage experiments, in which only a few plants of each type were enclosed in each cage, indicate, however, that factors other than microclimate are involved, since this must have been fairly constant and yet there was a marked difference in infestation on the two types. The authors suggest the possibility that infested bolls and buds of native varieties may be more easily shed than those of American varieties, thus destroying numbers of larvae and offering effective resistance to the biotic potential.

AHMAD (T.). **On the Biology of** *Euderus lividus* **(Ashm.), a Parasite of** *Agromyza obtusa* **Mall.**—*Indian J. Ent.* **2** pt. 1 pp. 59–64, 1 pl., 4 refs. New Delhi, 1940.

Seed pods of *Cajanus cajan* in India are attacked soon after they are formed by *Agromyza obtusa*, Mall.; eggs are deposited in them, and the larvae feed on the developing seeds and may destroy as many as 63 per cent. [*cf. R.A.E.*, A **26** 451]. The larvae are parasitised in the field by the Eulophid, *Euderus lividus*, Ashm., which has been bred from larvae collected in Bihar, Punjab and New Delhi; it has not previously been definitely recorded from this host or from India. The adults and pupae of *E. lividus* show marked sexual dimorphism in size, and the adults also in colour; the males are smaller than the females and, both in material collected from the field and in that reared in the laboratory, fall into two size groups, the smaller probably being produced as a result of poor nutrition. This fact at first led the author to state that two or three different Eulophids were involved in the parasitism [*cf.* **25** 530]. Oviposition was not observed, but is believed to take place through the hole cut in the pericarp by the Agromyzid larva before pupating, since almost all the parasitised larvae were full-fed and parasite eggs were in all cases observed near the hole. The number of eggs on a single host usually varied from 1 to 4, but ranged up to 9, and 2 or 3 larvae sometimes completed their development on a single host. The parasite pupates within the pod, and the adult escapes through the hole cut by the host larva. The immature stages are briefly described; the egg stage was completed in less than a day at 27 and 22°C. [80·6 and 71·6°F.] and in 2–3 days at 17°C. [62·6°F.], and the larval and pupal stages lasted 5–6 and 4–5, 7–9 and 7–8, and 20–21 and 18–19 days at these three temperatures, respectively. The Eulophid is scarce in winter, probably owing to its fairly high threshold of development; the percentage parasitism is about 4–7 in March, but increases to 50 in April. Since the parasite develops 1½ times as fast as its host under suitable conditions of temperature, the prospects of its success in controlling *A. obtusa* are good, provided that it can be carried through the winter by artificial means.

MUSTAFA (A. M.) & JANJUA (N. A.). **On the Biology of** *Spilonota ocellana* **Schiff. in Baluchistan.**—*Indian J. Ent.* **2** pt. 1 pp. 65–73, 3 figs., 9 refs. New Delhi, 1940.

An account, comprising the results of three years' investigations in the Quetta Valley, Baluchistan, is given of the bionomics of *Spilonota ocellana*, Schiff., the main features of which are similar to those already noticed [*R.A.E.*, A **27** 51]. In this region, *S. ocellana* is a serious pest of apple and quince and also causes slight damage to plum, peach

and cherry. The percentage reduction in the numbers of apples set owing to infestation was 68·3 in one apple orchard in 1937 and 67·4 on the same variety in another orchard in 1938. A detailed account is given of the feeding habits of the larvae; the immature stages, including the six larval instars, are described, and a description of the adult is quoted. The adults are active at dusk and rest by day on stems, twigs and the lower surfaces of leaves; they are rarely attracted to light or sugar bait. Females oviposit at night, beginning 2–5 days after emergence; oviposition continues from mid-May until late June. The maximum, minimum and average numbers of eggs deposited by single females were 123, 19 and 52·7.

Cherian (M. C.) & Subramaniam (C. K.). *Tetrastichus ayyari* **Rohw. —A pupal Parasite of some Moth-borers in South India.**—*Indian J. Ent.* **2** pt. 1 pp. 75–77, 4 figs., 3 refs. New Delhi, 1940.

The Eulophid parasite, *Tetrastichus ayyari*, Rohw., which was described from females reared from pupae of *Chilo zonellus*, Swinh., in Coimbatore [*cf. R.A.E.*, A **9** 136], has been bred by the authors from pupae of *C. zonellus*, *Diatraea* (*Argyria*) *sticticraspis*, Hmps., and *D. venosata*, Wlk., and has once been obtained from *Sesamia inferens*, Wlk. In the laboratory, it bred in the pupae of 15 other Lepidoptera belonging to several different families, a list of which is given. The adults usually emerge in the morning, and a host pupa may contain 3–6 emergence holes. Pairing takes place soon after emergence, and eggs are sometimes deposited on the same day. They are laid in the body-fluid of the pupa; the average number deposited by 8 females was 72·8, and one female gave rise to 98 adults. The larvae feed on the body-fluid of the host. The egg, larval, prepupal and pupal stages and total development last about 1, 7–8, 1–2, 6–7 and 14–16 days, respectively. Very brief descriptions are given of the immature stages, and of the antennae of adults of both sexes. The average longevities of 10 females and 10 males fed on dilute honey were 23 and 25 days, respectively, and the maxima were 37 and 38 days. The adults survived for only 3 days without food. During November–December 1939, 8 pairs gave rise to 35 males and 547 females. Parthenogenesis occurs, and all the parasites obtained from one field-collected host in July 1938 were males.

Krishna Ayyar (P. N.) & Narayanaswami (P. S.). **On the Biology of *Spathius vulnificus* Wilk. a possible effective Parasite of *Pempheres affinis* in South India.**—*Indian J. Ent.* **2** pt. 1 pp. 79–86, 2 figs., 3 refs. New Delhi, 1940.

In the course of a survey of the distribution and natural enemies of *Pempherulus* (*Pempheres*) *affinis*, Faust, on cotton, the senior author made a short tour towards the end of 1936 in northern India. Very few natural enemies of the weevil were observed, and they exercised little control. A search was therefore made for parasites of closely related species, and the Braconid, *Spathius vulnificus*, Wlkn., was found commonly parasitising *Dinoderus* sp. infesting stored bamboo in a town in the United Provinces. This parasite occurs throughout India, and as it is closely related to *S. critolaus*, Nixon, which parasitises both Bostrychids and weevils [*cf. R.A.E.*, A **27** 505], a consignment was sent to Coimbatore, where its bionomics were studied

during 1936–37 with a view to its possible utilisation against *P. affinis*.

In the laboratory, the females readily oviposited on larvae of *P. affinis* lodged in cells made in small cotton stalks, and the larvae successfully completed their development on them. Of the 206 parasites reared, 45 developed on larvae of *P. affinis* and 161 on larvae of *Hypolixus* (*Lixus*) *truncatulus*, F. The life-cycle lasted 19–29 days between December 1936 and April 1937. The maximum longevity for adults fed on sugar solution was 93 days for females and 72 for males. A minimum period of 4 days elapsed between emergence and oviposition, and the maximum interval was 56 days. An average of 28 eggs was laid per female, with a maximum of 89. The numbers laid on a single host and the numbers of adults that emerged varied considerably. A single female parasitised an average of 6 host larvae during its life and paralysed about 4 others without ovipositing on them. The immature stages are described ; there are 4 larval instars, and the egg, larval, prepupal and pupal stages lasted 40–64 hours and 4–7, 6–11 and 6–13 days, respectively. Only about 33 per cent. of the eggs gave rise to adults, possibly owing to overcrowding, and females were very much more numerous than males. Unfertilised females oviposited to some extent, but the eggs failed to develop. The economic possibilities of the parasite are discussed ; despite its high rate of mortality and low rate of multiplication under laboratory conditions, it is considered to be well adapted to parasitise *P. affinis*.

Short Notes and Exhibits.—*Indian J. Ent.* **2** pt. 1 pp. 93–98, 1 fig. New Delhi, 1940.

Y. Ramachandra Rao (pp. 93–94) states that during examinations of large numbers of locusts, colonies of green algae were observed among the folds of the hind wings of some of them ; they were most common on overwintered locusts and were never found on young adults. The spores are probably transferred from one individual to another by air and appear to require cool, moist conditions, such as are found during cold weather in places well covered with vegetation ; light winter rainfall is probably favourable. Their presence may give indications of the breeding ground from which the locusts originated and of the age of individual locusts.

S. Mukerji (p. 95) records an experiment in 1938 in which batches of 15 hoppers of *Schistocerca gregaria*, Forsk., were allowed to feed for 6 hours on moist baits containing 50 lb. bran, 2 lb. molasses or 1 lb. salt, and 1 lb. sodium fluosilicate or barium fluosilicate and were subsequently fed on fresh lucerne. After 96 hours, 13 of the hoppers given sodium fluosilicate were dead, as compared with 9 of those given barium fluosilicate, and none of a control batch.

A. Lateef (p. 96) states that in experiments with marked nymphs of *Drosicha stebbingi*, Green, a pest of mango in the Punjab, first-instar nymphs crawled a distance of about 40 ft. and second-instar nymphs as far as 150 ft. Adhesive bands on the trunks of mango trees act as repellents, the nymphs eventually coming to rest on weeds at a distance from them.

A. N. Sapra (p. 96) states that a mite of the genus *Bryobia* infests the upper surfaces of chrysanthemum leaves in the Punjab, causing them to wilt and fall. The overwintered eggs hatch towards the end of

March, and all stages are present until the beginning of November. Activity is greatest during April–July, and all stages except the eggs are subsequently killed by the monsoon rains.

P. N. Krishna Ayyar (pp. 96–97) reports the discovery of the Nematode, *Geomermis indica*, in a full-grown larva of *Pempherulus* (*Pempheres*) *affinis*, Faust, on *Triumfetta rhomboidea* near Coimbatore in October 1937. The parasite appears to be specific to *P. affinis*, and although its host attacks a number of plants, it has been found only in larvae on *T. rhomboidea* and in one on *Malvastrum coromandelianum*. The parasites are present during September–November, and in rare cases have been recovered in December and January. The number present in a single larva varies, but as many as 11–17 have been observed. When full-grown, they emerge by breaking through the intersegmental membrane of the abdomen of the host, thus causing its death. It is thought that rain stimulates the female Nematodes to climb up plants and oviposit on them ; the larvae on hatching attack young host larvae near the surface of stems or in superficial tunnels.

M. C. Cherian and K. Menon (pp. 97–98) briefly describe the immature stages of the Hispid, *Oncocephala tuberculata*, Ol., which occurs on sweet potato and was recently collected by them on *Ipomoea sepiaria* at Coimbatore. Under laboratory conditions, the maximum adult longevity was 50 days. The eggs are laid singly in the tissues of the leaves, and the larvae mine the leaves and cause them to wither. When full-grown, the larva constructs a short tunnel in a healthy leaf, in which it pupates. The egg, larval and pupal stages occupy 7–10, 17–23 and 8–15 days, respectively.

C. S. Venkatsubba Iyer (p. 98) reports that adults of *Rhynchophorus ferrugineus*, F., which is the most common pest of coconut in Cochin, are parasitised by larvae of *Sarcophaga fuscicauda*, Boettcher. When full-grown, the larvae leave their hosts and pupate, the adults emerging within a week. Large numbers of larvae of *R. ferrugineus* are destroyed by a rodent of the genus *Bandicota*, but it is itself a serious pest in gardens, especially of root crops. *Dasyneura mangiferae*, Felt, attacked 60–70 per cent. of the buds of mango in Cochin in 1938 and 1939. A single egg is usually deposited in each bud, and the larva feeds and pupates in it. The infested bud becomes enlarged into a gall.

KALSHOVEN (L. G. E.). **Observations on the Red Branchborer, *Zeuzera coffeae* Nietn. (Lep. Coss.).**—*Ent. Meded. Ned.-Ind.* **6** no. 3–4 pp. 50–54, 1 pl., 2 refs. Buitenzorg, 1940. (With a Summary in Dutch.)

In view of repeated references to *Zeuzera coffeae*, Nietn., as a minor pest of a great variety of plants in Java, including saplings of teak and other forest trees [*R.A.E.*, A **10** 625, etc.], and the lack of information on the life-history of this Cossid, breeding experiments were carried out in 1932–33 in a laboratory in central Java. Very little pairing occurred when adults from larvae and pupae collected in the surrounding teak forest were liberated in large cages, and better results were obtained by placing single pairs in glass jars. Oviposition began 7–8 hours after pairing, the process of which is described, and continued for 2–5 days. The eggs were laid in strings or clusters, with no apparent choice of site, and the numbers of larvae that hatched from the egg-masses of 4 females ranged from 348 to 966. The eggs from unfertilised females did not hatch. The moths lived for 5–11 days in the laboratory, and

the egg stage lasted 10–11 days. The newly hatched larvae remained under webs for about a day and then lowered themselves on threads and were carried away by the wind.

Attempts to rear the larvae in pieces of branch cut from teak or mahogany [*Swietenia*] were unsuccessful, but roots of cassava, from which this Cossid has not been recorded in the field, proved more satisfactory. Newly hatched larvae were introduced into small holes bored in the roots and subsequently plugged with cotton wool, and the roots were replaced by fresh ones every week. The percentage of larvae that reached the pupal stage was 15–25, and the durations of development from hatching to adult emergence averaged 81 and 87 days for males and females, respectively. Newly hatched larvae introduced into holes in living teak saplings and cassava stems did not survive for more than 6 weeks, but of 32 placed in small stems of *Hibiscus rosa-sinensis*, one gave rise to an adult 151 days after hatching and another to a pupa. In further tests, 50 larvae that had fed for a month in cassava roots were transferred to teak saplings. Six gave rise to adults 105–127 days after hatching, while of the others, six were extracted by woodpeckers and three were parasitised. When 25 larvae were similarly transferred to mahogany, two adults emerged 119 and 141 days after hatching and 2 were parasitised. The absence of sap-circulation in cassava roots is possibly responsible for the quicker larval development in them.

Rahman (K. A.) & Sapra (A. N.). **Mites of the Family Tetranychidae from Lyallpur with Descriptions of four new Species.**—*Proc. Indian Acad. Sci.* **11** no. 5 Sec. B pp. 177–196, 6 figs., 5 refs. Bangalore, 1940.

Descriptions are given of both sexes of seven mites found in Lyallpur, Punjab, with keys to the genera and species and notes on the biology of the latter. They comprise : *Tetranychus cucurbitae*, sp. n., which has been observed on a great number of plants, of which cucurbits, cabbage, tomato and hollyhock (*Althaea rosea*) are the most severely infested ; *T. telarius*, L., which is an important pest of many plants and sometimes occurs together with *T. cucurbitae* ; *T. mori*, sp. n., which occurs on the lower surface of the leaves of mulberry (*Morus alba*) ; *T. fici*, Hirst, which infests the lower surface of the leaves and unripe fruits of figs ; *Paratetranychus indicus*, Hirst, which causes serious damage to sugar-cane and *Sorghum* ; *P. mangiferus*, sp. n., which infests the upper surface of the leaves of mango (*Mangifera indica*), *Eugenia jambolana* and grape-vines ; and *Anychus ricini*, sp. n., which severely attacks the upper surface of the leaves of castor (*Ricinus communis*), almond (*Prunus amygdalus*) and *Cassia fistula*, and to a less extent those of *Zizyphus jujuba* and *Citrus*.

Rahman (K. A.). **Insect Pests of the Punjab.**—*Punjab agric. Coll. Mag.* **7** no. 5–7, 98 pp., 44 figs., many refs. Lyallpur, 1940.

This is a survey of data on some 50 of the principal insect pests of crops, fruit trees and stored products in the Punjab ; they are arranged under crops attacked, and notes are given on their appearance, biology and control. Separate sections deal with termites and the locust, *Schistocerca gregaria*, Forsk., and with insecticides and spraying and dusting machinery. The pests are mainly those of which the bionomics

are known and have been recorded in the annual reports and other papers of Afzal Husain, but they include the Pyralid, *Chilo trypetes*, Bisset [*cf. R.A.E.*, A **27** 456], which is stated to feed exclusively on sugar-cane and to be especially destructive to the early varieties.

Rahman (K. A.) & Kalra (A. N.). **Volant Animals which act as Carriers of San José Scale.**—*Curr. Sci.* **9** no. 5 p. 235. Bangalore, 1940.

With a view to finding the extent to which nymphs of *Aspidiotus* (*Quadraspidiotus*) *perniciosus*, Comst., are distributed by flying animals that visit infested fruit trees, 266 birds and bats, comprising 26 species of birds and the flying fox, *Pteropus giganteus*, were shot and examined. Nymphs of the scale were obtained from 6 species of birds and the bat ; the number of examples on which they were found is not stated.

Fukushi (T.). **Retention of Virus by its Insect Vectors through several Generations.**—*Proc. imp. Acad. Japan* **15** no. 5 pp. 142–145, 1 fig., 1 ref. Tokyo, 1939. [Recd. 1941.]

An account is given of further work in Japan on the persistence of the virus of dwarf disease of rice in successive generations of the Jassid vector, *Nephotettix bipunctatus* (*apicalis*, Motsch.) *cincticeps*, Uhler [*cf. R.A.E.*, A **23** 622]. Infective females were paired with infective or non-infective males and their progeny kept singly on healthy rice seedlings and transferred to a fresh plant each day. The infective females among them were paired with non infective-males, and the experiments continued until infective females did not appear among the progeny or did not oviposit. In this way, the virus was transmitted in two series to the F_2 generation, in two others to the F_3 generation and in one to the F_6.

At low temperatures, a prolonged incubation period was usually required for the virus in the plant, and since females that had grown too old were unwilling to mate, certain females reared during the winter were paired with non-infective males without waiting for proof of their infectivity. They were eventually shown to be non-infective, but some of their progeny were infective. It is considered that at low temperatures the increase of virus may be inhibited not only in the rice plant but also within the body of the insect vector. In such a case the virus is perhaps more or less localised in its distribution and movement through the insect body. It may migrate to the salivary glands and so be injected into plant tissues, or it may become localised in the ovarian tubules and pass to the eggs. In the case in which the virus was transmitted to the F_6 generation, it had been retained within insect bodies for over a year, but was scarcely if at all reduced in virulence, since a majority of the infective F_5 individuals produced infections in all the plants (50–80) on which they were confined for a single day.

Bianchi (F. A.). **Some interesting new Records in the Thysanoptera.**—*Proc. Hawaii. ent. Soc.* **10** (1939) no. 3 pp. 375–376. Honolulu, 1940.

These records of Hawaiian thrips include one of *Podothrips lucasseni*, Krüg., on *Valota insularis* growing to the southeast of a Forest Reserve

about 1,500 ft. above sea level and more than a mile from the nearest sugar-cane. It has hitherto been recorded only on sugar-cane, and recent observations indicate that it is a very important predator of the sugar-cane stalk mite, *Tarsonemus spinipes*, Hirst, in Hawaii.

BIANCHI (F. A.). **Notes on the Role of the self-introduced Insects in the economic Entomology of Hawaii.**—*Proc. Hawaii. ent. Soc.* **10** (1939) no. 3 pp. 377–388. Honolulu, 1940.

This presidential address comprises a survey, based on papers by members of the Hawaiian entomological society, of insects that have been accidentally introduced into the Territory of Hawaii and are predacious or parasitic on other insects, together with notes on their probable importance.

HOLDAWAY (F. G.). **Differential Susceptibility of Varieties of Garden Bean to Oviposition by Melon Fly,** *Dacus cucurbitae* **Coq.**—*Proc. Hawaii. ent. Soc.* **10** (1939) no. 3 pp. 421–422, 1 ref. Honolulu, 1940.

Dacus cucurbitae, Coq., is not usually considered to be a pest of string beans, though it has been recorded as attacking them in Hawaii [*R.A.E.*, A **3** 163], but it may cause fairly severe damage if it is numerous and there is a scarcity of more attractive fruits. In June 1938, it was the most serious pest of string beans in a locality on Oahu where cucumbers and tomatos had been grown for several months and had been severely attacked, with the result that it was still very numerous when few cucumbers and tomatos remained. It attacked the pods of all the four varieties grown, but three of them exhibited differential susceptibility, 1·1, 5·9 and 8·7 per cent. of the pods showing evidence of oviposition.

HOOD (J. D.). *Organothrips bianchii*, **a new Hawaiian Thrips from Taro.**—*Proc. Hawaii. ent. Soc.* **10** (1939) no. 3 pp. 423–427, 5 figs. Honolulu, 1940.

Descriptions are given of the macropterous female and apterous male of *Organothrips bianchii*, gen. et sp. n., taken on taro (*Colocasia esculentum*) on Oahu in March and July 1939. The affinities of the genus are not clear, though it is evidently a primitive member of the THRIPIDAE with several adaptive structures peculiar to itself. It is stated in notes by F. A. Bianchi that both adults and immature forms occur on the inner surface of the outer stems of plants growing in water, in the three or four inches above the water line. No thrips were found on taro growing in moist soil or in mud recently covered by water. Both young and adults are sluggish. The eggs are laid just under the epidermis of the plant. The species is well distributed on Oahu and was observed on Hawaii in August 1939.

LINFORD (M. B.). **Pineapple Fruit Injuries caused by Larvae of the Moths** *Ereunetis flavistriata* **and** *Pyroderces rileyi*.—*Proc. Hawaii. ent. Soc.* **10** (1939) no. 3 pp. 437–445, 9 figs., 5 refs. Honolulu, 1940.

The following is substantially the author's summary. Minor injuries to pineapple fruits by larvae of *Decadarchis* (*Ereunetis*)

flavistriata, Wlsm., and *Pyroderces rileyi*, Wlsm., are described and illustrated. Larvae of *D. flavistriata* feed in the crevices between fruitlets on protected surfaces of fruits ranging from less than half grown to fully ripe. On green fruits, the wounds, which vary from shallow pits to rounded holes, heal with wound cork. Wounds on ripe fruits, however, do not heal, but are attractive to insect vectors of micro-organisms that accelerate their deterioration. During March and April 1939, this insect injury was recorded on Lanai, Oahu and Kauai, and was seen on almost every mature fruit in some fields. Larvae of *P. rileyi* feed on withered floral parts enclosed within blossom cups, usually without injuring the fruit. In the Makawao area, Maui, during August and September 1933, however, injury was common, the larvae eating through the bases of styles, stamens or petals into the ripening flesh. Species of *Penicillium*, usually present on the withered floral parts, entered these wounds and produced a characteristic dark brown rot of limited extent. This injury was more abundant in the Cayenne than the Hilo variety, and, in the Cayenne, was more prevalent in fruits from crowded plants and plants from inside rows of 4-row beds than in fruits developed under full exposure.

Sakimura (K.) & Linford (M. B.). **An annotated List of Insects from Lanai.**—*Proc. Hawaii. ent. Soc.* **10** (1939) no. 3 pp. 451–454. Honolulu, 1940.

The 92 insects listed were taken during a study of the epidemiology of certain pineapple fruit diseases, and collected in several ways with the particular object of obtaining insects that visit ripe or wounded fruits and those that emerge from rotting fruits.

Swezey (O. H.). *Melittobiopsis ereunetiphila* **Timberlake, an efficient Parasite on the Sugar Cane Bud Worm in Hawaii.**—*Proc. Hawaii. ent. Soc.* **10** (1939) no. 3 pp. 457–458. Honolulu, 1940.

Injury to sugar-cane by the larvae of *Decadarchis* (*Ereunetis*) *flavistriata*, Wlsm., at the experiment station at Honolulu has of recent years been much less evident than usual, and observations in one plot in May 1939 showed that nearly 90 per cent. of the larvae in their cocoons had been parasitised by *Melittobiopsis ereunetiphila*, Timb., up to 30 pupae of which were found in a single host cocoon. This Eulophid, which was described from *D. flavistriata* on sugar-cane at Honolulu and coconut on Kauai [*R.A.E.*, A **14** 544], had previously been recorded in Hawaii as *Melittobia hawaiiensis*, Perkins [**3** 681]. In 1925, the author obtained three examples from an old cocoon of *Rhabdocnemis obscura*, Boisd., at Honolulu. His observations suggest that the female enters the cocoon of *D. flavistriata* before it is completed and oviposits indiscriminately on the surface of the mature larva. The eggs are laid singly or in groups and hatch very quickly. The larvae feed externally on the host, become full-grown in about a week and pupate 2–3 days later. The pupal stage lasts about a fortnight. In May 1939, *M. ereunetiphila* was reared from larvae of *D. flavistriata* on pineapple on Oahu.

Swezey (O. H.). *Micromalthus debilis* **LeConte in Hawaii (Coleoptera : Micromalthidae).**—*Proc. Hawaii. ent. Soc.* **10** (1939) no. 3 p. 459. Honolulu, 1940.

An adult and larvae of *Micromalthus debilis*, Lec., were taken from timber, including the rotten butt of a telephone pole that had been pulled up, on Oahu in 1925. This species is widely distributed in the eastern United States and has recently been found injuring timbers in gold mines in the Transvaal [*R.A.E.*, A **27** 60].

Comstock (J. H.). **An Introduction to Entomology.**—9th edn (revd), Med. 8vo, xxi+1064 pp., portr., 1228 figs. Ithaca, N.Y., Comstock Pub. Co., Inc., 1940. Price $5·00.

The ninth edition of this standard work has been revised by G. W. Herrick to include new developments and, in a few cases, to give precedence to more recent views, but in general the bulk of the subject matter and its arrangement in the original edition [*cf. R.A.E.*, A **12** 77 ; **13** 235] have been retained.

The first part (pp. 1–205) comprises four chapters on the characteristics of insects and the other Arthropod classes, and the external and internal anatomy and metamorphosis of insects. In the second (pp. 206–1007), which deals with classification and life-histories, one chapter is devoted to each of the 26 orders of insects recognised, and keys to the families of most of the orders represented in North America are included. The principal alteration lies in the expansion of the sections on the superfamilies Ichneumonoidea, Proctotrupoidea and Chalcidoidea, which contain the parasites of greatest economic importance, owing to the increased interest in the biological control of pests of crops. Keys by H. K. Townes to the subfamilies of the Ichneumonidae and the families of the Chalcidoidea are included.

Morris (V. H.), Neiswander (C. R.) & Sayre (J. D.). **Toxicity of Selenium-containing Plants as a Means of Control for Red Spiders.**—*Plant Physiol.* **16** no. 1 pp. 197–202, 6 refs. Lancaster, Pa., 1941.

In connection with recent investigations on the effect on Aphids and *Tetranychus telarius*, L., of selenium taken up by infested plants from the soil or nutrient solutions [*cf. R.A.E.*, A **24** 768 ; **29** 165, 207], laboratory experiments were carried out in Ohio to determine concentrations of selenium administered as sodium selenate that would not be toxic to maize but would kill the mite.

The plants were grown in various nutrient solutions, the composition of which is given, in cement tanks. In the first of two preliminary experiments, the mite populations were reduced by the addition of 2 and 3 parts per million selenium, and in the second, plants grown in a nutrient solution that received 2 p.p.m. selenium at intervals of 10 days were almost free from infestation, whereas those in the control tank were practically dead as result of mite injury. The selenium did not injure the plants.

In further experiments in 1937 and 1938, in which the plants were artificially infested with mites and selenium added to the nutrient solutions at intervals of 1 or 2 weeks and at rates of 0·5, 1, 2 and 3 p.p.m., analysis showed that the leaf tissues contained approximately 25, 50, 100 and 150 p.p.m., respectively, of selenium at harvest. The

mites were not killed on foliage containing 25 p.p.m. selenium, though the infestation did not cause much injury. At 50 p.p.m. selenium content, infestation was inhibited, though occasional sluggish individuals were found, while at concentrations of about 100 p.p.m. or above, no living mites occurred on the plants and there was no injury. Control plants, of which the tissues contained only 1–5 p.p.m. selenium, were severely infested and in most cases killed by the mites.

The control plants became severely infested during the summer with *Aphis maidis*, Fitch, but no Aphids were observed on maize receiving selenium. The addition of selenium to sand or soil cultures at the rate of 1–10 p.p.m. in subsequent nutrition studies in Ohio with young apples, elms, legumes and wheat gave complete control of *T. telarius*.

HEDDEN (O. K.) & NEISWANDER (C. R.). **Equipment for burning Sulfur in empty Greenhouses and in Mushroom Houses for the Destruction of Mites and Insects.**—*Bi-m. Bull. Ohio agric. Exp. Sta.* **25** no. 204 pp. 63–72, 8 figs., 1 ref. Wooster, Ohio, 1940.

The practice of fumigating greenhouses and mushroom houses with sulphur between crops to destroy mites and insect pests [*cf. R.A.E.*, A **22** 416; **23** 470, 549] has been generally adopted in the United States, but no entirely satisfactory method of burning the sulphur has been developed, and the operation is frequently unsuccessful because much of the charge fails to burn. During 1937–39, work was carried out on the improvement of fumigators to overcome this difficulty, and two types, one depending on convection and the other on a small blower for circulating air and dispersing the fumigant, were evolved; both are figured and described in this paper, and the method of working explained.

The natural draught fumigator comprises two circular steel trays for the sulphur, with a circular grate for the fuel between them. The openings in the floor of the grate should be as large as possible without allowing the fuel to fall into the lower tray. The trays and grate are spaced by supporting pieces so that air can pass freely between them. Trays 22½ ins. in diameter and 6 ins. deep are capable of burning 50–80 lb. sulphur; where the smaller charge is used, 35 lb. should be placed in the top and 15 lb. in the bottom tray. About 10–15 lb. charcoal briquettes steeped in kerosene is required for fuel, and 2 or 3 burning briquettes placed in each tray ensures early ignition. Considerable heat is liberated, and this type of fumigator is most suited for use in large houses having a high roof and enclosing a space of 100,000 cu. ft. or more. If used in smaller houses, it should be covered by a metal shield to protect adjacent woodwork. Where as much as 200 lb. sulphur is needed, three or four fumigators should be employed. In a mushroom house in which a total of 150 lb. commercial grade sulphur flour, used at the rate of 5½ lb. per 1,000 cu. ft. of space, was burned by three fumigators within an hour, no combustible residue remained in any of the fumigators; a concentration of 41·6 mg. per litre was reached, and the concentration remained above 10 mg. per litre for over 2¼ hours. Ten samples of tomato leaves infested with *Tetranychus telarius*, L., were distributed throughout the house; all the mites were destroyed, and an equally satisfactory kill would probably be given by a considerably smaller dosage.

The forced draught fumigator is more expensive, but it is more easily controlled and regulated and involves less risk of fire; it is therefore

more suited for use in small houses. Its structure resembles that of the other type, but the trays and grate are enclosed in an outer metal shell from the bottom of which an outlet pipe conducts the fumigant into the house and along its floor, and an air-inlet pipe, fitted with a damper, is connected to a small blower, which should be capable of delivering about 250 cu. ft. air per minute. An initial charge of 10 lb. sulphur is placed in the lower tray, and further charges are added at the rate of 10 lb. every 10 minutes by means of a funnel in the top of the fumigator leading to a tube that passes to the upper tray; an overflow pipe conveys excess of molten sulphur from the upper to the lower tray. A load of 3 lb. charcoal briquettes that have absorbed 1 U.S. pint kerosene is required for fuel. Adults and eggs of *T. telarius* distributed at various positions in two houses that were fumigated with sulphur at the rate of rather more than $2\frac{3}{4}$ lb. per 1,000 cu. ft. were all destroyed. Maximum concentrations of 20–30 mg. per litre were obtained both near the top and near the floor of the house [*cf.* **22** 416], and it is thought that a maximum concentration of only 10 mg. per litre would give complete mortality.

McDaniel (E. I.). **Summer Sprays for Control of the Gladiolus Thrips.** —*Quart. Bull. Mich. agric. Exp. Sta.* **23** no. 1 pp. 8–9, 2 refs. East Lansing, Mich., 1940.

A brief account is given of experiments against *Taeniothrips simplex*, Morison, on *Gladiolus* in Michigan in 1939 in which sprays of tartar emetic or calcium antimony tartrate, both with brown sugar [*cf. R.A.E.*, A **29** 204] gave better quality flowers, less injury to the foliage and 10–15 per cent. more effective control of the thrips than sprays of Paris green and brown sugar. *T. simplex* can be killed by a contact spray, but it is usually necessary to repeat the application three times at intervals of 48–72 hours; a spray of 1 U.S. pint nicotine sulphate in 100 U.S. gals. water, with the addition of 4 lb. laundry soap or 4 oz. sulphated alcohol spreader, applied at 250–400 lb. pressure, reduces an infestation and often makes it possible to harvest a good crop.

At harvest time when the corms are taken out of the ground, the tops should be cut as soon as possible to prevent the thrips migrating from the wilting foliage to the corms, and the latter should be cured in deep shade as far from the source of infestation as possible and stored over winter in a well ventilated place at a temperature of 40–50°F.

Swenk (M. H.) & Tate (H. D.). **Control of the Chinch Bug in Nebraska.**—*Circ. Neb. agric. Exp. Sta.* no. 61, 19 pp., 7 figs., 2 refs. Lincoln, Neb., 1940.

Swenk (M. H.) & Whelan (D. B.). **Control of Stored Grain Pests in Nebraska.**—*Op. cit.* no. 62, 11 pp., 9 figs. 1940.

The first of these circulars comprises an account of the bionomics of *Blissus leucopterus*, Say, as a pest of cereals in Nebraska and of measures for its control, chiefly the cultivation of immune crops or resistant varieties of susceptible ones, crop rotation, and the use of barriers to prevent migration of first-generation nymphs from small grains to maize or *Sorghum* [*cf. R.A.E.*, A **29** 245]. The history of outbreaks of this Lygaeid in Nebraska is briefly reviewed.

The second paper includes brief descriptions of the chief insects attacking stored grain in Nebraska [*cf.* **10** 298], with notes on methods for preventing infestation and on control by fumigation with carbon bisulphide or a mixture of ethylene dichloride and carbon tetrachloride.

Swenk (M. H.) & Tate (H. D.). **The Potato Flea Beetle and the Potato Psyllid in Nebraska.**—*Bull. Neb. agric. Exp. Sta.* no. 327, 19 pp., 6 figs., 13 refs. Lincoln, Neb., 1940.

Potatoes are severely injured in western Nebraska by the nymphs of *Paratrioza cockerelli*, Šulc, which cause Psyllid yellows [*cf. R.A.E.*, A **26** 578] and *Epitrix cucumeris*, Harr. All stages of these pests are described, and an account is given of their bionomics, based partly on the literature and partly on observations carried out in Nebraska between 1928 and 1937. Since the larvae of the flea-beetle, which feed on the roots and tubers of potatoes, cause more serious damage than the adults, which feed on the foliage, the plants should be sprayed with zinc arsenite at the rate of 2 lb. per 40 U.S. gals. water when the flea-beetles first appear on the foliage, and an effective coverage of poison maintained until the peak of activity is over, so that oviposition is prevented. Potatoes planted before 10th June are more likely to be injured by the larvae than those planted after about 20th June. There are two generations a year.

The Psyllid completes its life-cycle in about 3 weeks and has several generations a year. Effective control on potatoes can be obtained by spraying with 1 U.S. gal. liquid lime-sulphur (32° Bé) or 4–5 lb. dry lime-sulphur in 40 U.S. gals. water, before the symptoms of Psyllid yellows appear. A protective spray each year when the plants are 6–8 ins. high is recommended. Control of both pests is obtained by adding zinc arsenite to the lime-sulphur spray [*cf.* **26** 643].

Reference is made to List's recommendation for the control of the Psyllid on tomato [**29** 21].

Ripley (L. B.) & Petty (B. K.). **Dusting for Froghopper in Wattles.** —*Fmg in S. Afr.* 1940 repr. no. 48, 2 pp., 2 figs. Pretoria, 1940.

Tests with contact insecticides against a Capsid [*Lygidolon laevigatum*, Reut.] and a Jassid [*Bythoscopus cedaranus*, Naudé], which together with other Jassids of minor importance are responsible for "froghopper" damage to wattle [*Acacia*] in South Africa [*cf. R.A.E.*, A **15** 330; **18** 9], showed that a proprietary pyrethrum powder was the most effective [*cf.* **29** 19]. Talc was the best diluent tested, and a dust of pyrethrum powder and talc (1 : 20) gave satisfactory results in laboratory and field tests, though a strength of 1 : 15 may prove to be necessary for good results in the field under some conditions. At such concentrations, the dust killed practically all the Jassid nymphs in the laboratory, as well as about half the adults and a high percentage of adults of the Capsid. Applications of 5–20 lb. mixed dust per acre, according to the size of the trees, will probably be necessary; trees more than 12 ft. high are unlikely to need treatment. The cost is discussed and considered economic.

It is emphasised that it is usually too late to dust the trees when the witch's broom type of damage has begun to show. As there are several generations of the insects in the year, injury may be caused at

various times, but, in general, most of it occurs during the latter half of the summer. All young plantations should be examined every week or two from November onwards, and dusting should be carried out as soon as the insects become numerous, wherever they are abundant and preferably before any of them reach the adult stage. One dusting per season will probably be sufficient.

LEVER (R. J. A. W.). **Entomological Notes. 1. Further Notes on the Green Vegetable Bug.**—*Agric. J. Fiji* **11** no. 3 pp. 81–82, 3 refs. Suva, 1940.

Specimens of *Nezara viridula*, L., from Viti Levu, where it was recorded, for the first time in Fiji, in 1939 [*cf. R.A.E.*, A **29** 170], have been identified as belonging to the variety *smaragdula*, F. This Pentatomid has since been observed on tomato near Suva and on lettuce, *Sonchus asper* and an introduced species of *Ageratum* in a hill-station on Viti Levu at a height of 2,600 ft. above sea-level, where it is believed to have been present for two years. It has also been taken on Vanua Levu, into which it was probably introduced on vegetables from Suva.

In the laboratory, eggs were deposited in groups of 51–95 on the lower surfaces of tomato leaves. In the cool season, at a temperature of 66–80°F., the egg stage lasted 6–8 days, and the five nymphal instars were completed in 32–42 days. Adults survived wetting with 1 part white oil in 20 parts water, while a spray containing 1 oz. pyrethrum and ½ oz. laundry soap in 1 gal. water destroyed the young nymphs but only 50 per cent. of the adults. The collection and destruction of the egg-masses is the most effective means of control and can be supplemented by jarring the adults into a net of sacking that has been soaked in kerosene.

Codling Moth and Black Spot. Fourth Annual Report of the Apple and Pear Demonstration Plots.—*J. Dep. Agric. Vict.* **38** pt. 8 pp. 383–387, 406–410, 8 figs. Melbourne, 1940.

A brief summary is given of the work on the control of *Cydia pomonella*, L., in Victoria in 1936–39 [*cf. R.A.E.*, A **28** 315], followed by an account of investigations in the season of 1939–40, when various schedules involving a calyx spray of lead arsenate (3 lb. per 100 gals. water) and cover sprays of lead arsenate or white oil emulsion (1 : 80), separately or in combination, were tested on pears and apples in different districts in demonstration plots. The results are shown in tables. It is concluded that the best schedule to use differs with the district and variety of apple or pear, and separate recommendations for the various districts are therefore given.

The use of bands has become common as a secondary control measure. Bands of sacking, which must be examined every 10–12 days, are recommended for use on pear trees instead of chemically treated bands, as the roughness of the trunks enables the larvae to pupate out of contact with the toxic chemical. Treated bands give good results on apple trees, provided that the trunks and limbs are scraped regularly to remove loose bark, in which the larvae may pupate, and the cracks are filled.

HALLIDAY (O. E.). **Mealy Bug Infestation of Citrus Trees.**—*J. Dep. Agric. S. Aust.* **43** no. 12 pp. 847–851, 3 figs. Adelaide, 1940.

A popular account is given of the bionomics of *Pseudococcus adonidum*, L. (*longispinus*, Targ.) and *Icerya purchasi*, Mask., on *Citrus* in South Australia, where both are commonly known as mealybugs. They do not constitute a serious pest of *Citrus* in the inland districts, except in the Murray River area, but are difficult to control, since fumigation with hydrocyanic acid gas, even at dangerously high concentrations, has not given satisfactory mortality and sprays of heavy oil, though fairly effective, have had to be applied at frequent intervals. Thorough spraying at a pressure of at least 300 lb. per sq. inch is essential. *Citrus* should never be sprayed when flowering, and orange fruits should reach one-third of their final size before oil is applied.

Both Coccids are attacked by parasites and predators, particularly Coccinellids, one of which [*Rodolia cardinalis*, Muls.] is used for the control of *I. purchasi* in California. Chrysopid larvae are also of some importance. Where *Pseudococcus* is troublesome, bands of sacking should be placed round occasional *Citrus* trees to provide shelter for it during the winter. The mealybugs are then easily found by the Coccinellids, which are able to multiply and are protected from their own parasites. When an outbreak is spreading and the trees are materially damaged, they should be sprayed with 2 gals. white oil in 80 gals. water, alone or with the addition of 1 pint nicotine sulphate. These sprays will also control other Coccids.

PAPERS NOTICED BY TITLE ONLY.

HAYWARD (K. J.). **Contribución a la bibliografía sobre las moscas de las frutas.** [A Contribution to the Bibliography on Fruit-flies (about 1,000 titles).]—*Bol. Estac. exp. agríc. Tucumán* no. 31, 42 pp. Tucumán, 1940.

FULLAWAY (D. T.). **A new Egg-parasite** [*Ootetrastichus megameli*, sp. n.] **of the Taro Leafhopper** [*Megamelus proserpina*, Kirk., in Philippines].—*Proc. Hawaii. ent. Soc.* **10** (1939) no. 3 pp. 411–412. Honolulu, 1940. [*Cf. R.A.E.*, A **26** 213.]

BERG (V. L.). **The External Morphology of the Immature Stages of the Bee Fly,** *Systoechus vulgaris* **Loew (Diptera, Bombyliidae), a Predator of Grasshopper Egg Pods** [in Saskatchewan].—*Canad. Ent.* **72** no. 9 pp. 169–178, 6 figs. Guelph, 1940.

MORRISON (F. O.). **A Revision of the American Species of** *Gonia* **Meigen (Diptera: Tachinidae).**—*Canad. J. Res.* (D) **18** no. 9 pp. 336–362, 50 figs., 26 refs. Ottawa, 1940.

HUTCHINS (R. E.). **Insect Activity at a Light Trap during various Periods of the Night.**—*J. econ. Ent.* **33** no. 4 pp. 654–657, 4 figs., 6 refs. Menasha, Wis., 1940.

Supplementary List of Common Names of Insects [32 new popular names, 1 changed name and 2 additional names].—*J. econ. Ent.* **33** no. 4 pp. 708–709. Menasha, Wis., 1940. [*Cf. R.A.E.*, A **28** 208.]

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ENTOMOLOGICA AMERICANA (BROOKLYN, N.Y.):
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JOURNAL OF THE BOARD OF AGRICULTURE OF BRITISH GUIANA (DEMERARA) Vol. III No. 1 (1909). Title pp. and Indices to Vols. I–II.

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NEW YORK STATE MUSEUM (ALBANY, N.Y.): Bulletin: 26 & 57 (1899–1902).

ONTARIO ENTOMOLOGICAL SOCIETY REPORT (TORONTO): 9th (1878).

ORMEROD (E. A.). OBSERVATIONS OF INJURIOUS INSECTS AND COMMON FARM PESTS DURING THE YEARS 1877 & 1878 (London, 1878–79).

PHILIPPINE AGRICULTURIST AND FORESTER (MANILA):
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PHILIPPINE JOURNAL OF SCIENCE (MANILA): Vol I (1906) No. 10.

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Journal, Vol. I (1917) No. 3.

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SCIENCIA MEDICA (RIO DE JANEIRO): Anno 1 Nos. 2–3, 5–6; II Nos. 1–10, 12.

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UNITED STATES DEPARTMENT OF AGRICULTURE (WASHINGTON, D.C.):
Howard (L. O.). Report of the Entomologist, 1895.

VIRGINIA: AGRICULTURAL EXPERIMENT STATION (BLACKSBURG, Va):
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VIRGINIA: 1st ANNUAL REPORT OF THE STATE INSPECTOR FOR SAN JOSÉ SCALE, 1896–97 (Richmond, Va, 1897).
4th Report of the State Entomologist and Plant Pathologist (Richmond, Va, 1905).

WEST INDIAN BULLETIN (BARBADOS): Title-page & Index to Vol. IV.

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